JOURNAL
OF
ECONOMIC ENTOMOLOGY

OFFICIAL ORGAN AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

Vol. 5 APRIL, 1912 No. 2

Proceedings of the Twenty-fourth Annual Meeting of the American Association of Economic Entomologists (*Continued*)

Morning Session, Thursday, December 28, 10 A. M.

President F. L. Washburn: The meeting will please come to order. The first thing on the program is the discussion of the President's address. Do you care to say anything upon the address? Evidently not. We will go on with the program. The first paper will be read by Mr. Johanssen, entitled, "Wire Worms in Corn and Potatoes."

WIRE WORMS IN CORN AND POTATOES

By O. A. Johanssen, *Orono, Me.*

(*Withdrawn for publication elsewhere*)

President F. L. Washburn: Any discussion of this paper?

W. C. O'Kane: We had one experience with wire worms in our Horticultural Department at Durham, N. H., this year, and I should like to have some one explain it. The Horticultural Department started out on some tests with potatoes, on land that had been in sod for forty years. Some of the plots were manured with common barnyard manure; some were not. The wire worms were abundant throughout the whole. The manured plots showed severe injury from wire worms; the unmanured plots showed very little.

President F. L. Washburn: Any other point to be brought out in connection with this paper? I understand, Mr. Johannsen, that you got negative results with Sherwin-Williams' soil fumigant. We had the same experience in Minnesota, and I understand that Sherwin-Williams have given it up. They tell me this that it doesn't amount to very much.

The next paper will be presented by Dr. T. J. Headlee:

THE TIME WHEN WHEAT SHOULD BE SOWN TO ESCAPE THE FALL BROOD OF HESSIAN FLY

By THOMAS J. HEADLEE, PH.D., *Head of the Division of Entomology and Zoology in the Kansas State Agricultural College and Experiment Station**

This is a phase of the Hessian fly problem which has received more or less attention from every student of that subject, and I should not presume to take the time of this association were it not for the fact that I believe it still to be an open question, and one in need of fundamental study.

There can be no doubt that the seasonal periodicity so characteristic of animals and plants generally is exhibited in both the Hessian fly and its host plants—that there is a period of time in the fall during which, under normal conditions of food supply, the emerging flies have the best possible opportunity to perpetuate their kind and that there is likewise a period during which wheat placed in the soil stands the best chance to produce the maximum yield. This period may be designated as the normal time of fall-brood fly emergence and the normal time for wheat sowing respectively. The problem of determining when wheat should be sown to escape the fall brood of fly involves the explanation of the relationship existing between the normal period of fly emergence and the normal period of wheat sowing. Fortunately, experimental tests of the former have been made and recorded in several parts of the country and of the latter in the state of Ohio. One sowing experiment at Columbus[1] continued for nine years gave a normal wheat sowing period of about five and one-half weeks, beginning September 6 and extending to October 15. Another sowing experiment at Wooster,[2] continued also for nine years, gave a period of four weeks, beginning August 31 and ending September 29. The investigations of Webster[3] have shown that the end of the injurious fall brood of fly is reached by September 25 at Columbus and September 20 at Wooster. Thus the normal period of fly emergence is seen to close one to three weeks before the normal period of wheat sowing comes to an end. These normal periods for parasite and host vary in time of occurrence with the latitude and with altitude. This variation is, of course, due to the changes in the climate characteristic of different latitudes and altitudes. To go deeper, we may say that within the limited area covered by the work of Webster and Hopkins, temperature is, in the light of our present knowledge, the only climatic factor sufficiently variable to bring about such large differences.

[1] Bul. 136, Ohio Expt. Sta., p. 13, 1902.
[2] Bul. 231, Ohio Expt. Sta., p. 6, 1911.
[3] Webster, F. M., Bul. 107, Ohio Expt. Sta., p. 275, 1899.

Relation of Time of Seeding to Yield, Columbus, Ohio.

Date of Seeding	1879	1880	1883a	1883b	1884	1886	1887	1888	1889	1890	
8-(22-25)			24.1		35.8		31.7	12.8		16.8	
8-(29-31)				40.0	51.8	41.2	31.6	11.2		16.8	
9-(6-10)	33.2	32.5	34.9		55.6	32.3	28.3	12.1	34.9	19.1	
9-(13-17)	30.3	33.0		42.4	57.2	35.0	31.3	26.6	26.9	20.2	
9-(20-24)	36.4	33.5	34.2	44.7	53.2	38.6	27.8	26.6	27.4	20.9	Date of Safe Sowing
9-(27-30)	32.7	29.5		47.1	54.6	42.1	26.1	26.1	42.4	22.5	Date of Sowing to
10-(4-8)	26.2	28.2	34.7		56.9	36.5	38.7	28.2	47.3	26.5	obtain Maximum Yield
10-(11-15)				38.0	44.4	38.0	30.6	33.0	33.8	22.6	
10-(18-20)					43.6	29.9	20.9	20.8		23.0	
10-(25-27)					35.6	18.9		27.7			

Relation of Time of Seeding to Yield, Wooster, Ohio.

Date of Seeding	1902 Valley	1903 Mealy	1904 Mealy	1905 Mealy	1906 Mealy	1907 Mealy	1908 Mealy	1909 Perfection	1910 Gypsy	Nine year Average	
(8-31)-(9-1)	25.00	30.66	17.33	26.16	39.33	21.83	40.17	36.17	16.92	28.17	
9-(7-8)	26.80	28.00	19.92	22.76	42.75	30.00	45.08	35.50	21.75	30.28	
9-(14-15)	25.50	34.33	23.92	17.58	40.75	31.75	46.75	35.50	26.08	32.24	
9-(20)											Date of Safe Sowing
9-(21-22)	28.50	36.83	24.33	20.50	47.66	31.58	47.12	38.67	26.08	33.61	Date of Sowing to Obtain Maximum Yield
9-(28-29)	25.50	30.66	24.33	18.92	47.08	33.50	46.25	38.58	24.58	32.16	
10-(5-6)	25.50	26.91	19.33	14.26	36.58	28.42	38.17	35.08	23.58	27.54	
10-(12-13)	22.10	21.00	19.87	13.76	33.33	25.08	33.50	36.08	23.42	25.35	
10-(19-20)	15.50	15.25		10.50	28.08	17.08	25.25	31.25	22.54	18.38	
10-(26-27)	9.33	12.41		3.58	25.16	11.25	24.17	15.67	23.33	14.43	

Although almost every writer on Hessian fly has recommended the employment of late sowing as one of the means of control, no important attempt was made to understand the underlying cause for the observed fact until the work of Webster in Ohio and Indiana. Through the medium of widely scattered seedings made throughout the normal period of wheat sowing, Webster was able to show a distinct ratio between the dates of the disappearance of fall brood and the latitude, and this ratio was determined as about one day for each one fourth of a degree, the fall brood disappearing one day earlier for each one fourth of a degree north and one day later for each one fourth of a degree south of a given point. One year later, Hopkins[1] confirmed in West Virginia the latitude ratio obtained by Webster in Ohio and showed that wherever altitude was sufficiently variable to bring about a difference in climate, there existed a ratio between the disappearance of the fall brood and the height above the sea. He showed that a difference of 100 feet in altitude made a difference of one day in the time of disappearance of the fall brood, one day earlier if 100 feet higher and one day later if 100 feet lower than a given point. Although Hopkins did not attempt to state these ratios in the form of a law, he set them forth for the first time with sufficient clearness to merit such a designation. In substance he said, under normal climatic conditions the date of the disappearance of the fall brood of Hessian fly and consequently the date of safe sowing of wheat varies with latitude and altitude, being one day earlier if north one fourth of a degree or higher by 100 feet, or one day later if south one fourth of a degree or lower by 100 feet than a given point. This ratio may well become known in Hessian fly annals as "Hopkins Law of Latitude and Altitude."

The universality of this law may be tested by applying it to determine the date of safe sowing over the fly-infested parts of the United States generally. The writer purposes to test it in the light of studies made in Kansas. During each of the last four years, a series of stations has extended from the north to the south boundary of the state through the eastern edge of the great central wheat belt. During each of the last three years, a parallel series has extended through the western edge of that portion of the wheat belt infested with fly.

The individual stations of the eastern series are located from north to south at Marysville, Manhattan, Marion, Sedgwick, Wellington, and Caldwell. The individual stations of the western series are located from north to south at Norton, Smith Center, Wilson, Great Bend, Pratt and Sawyer. During the first two years, representatives of the Bureau of Entomology participated in securing and handling

[1] Hopkins, A. D., Bul. 67, W. Va. Expt. Sta., 1900.

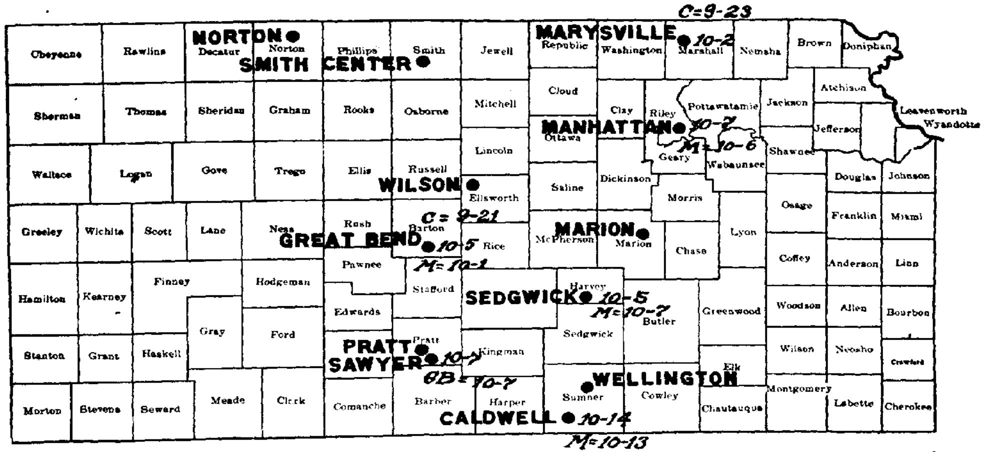


Fig. 1. Map of the State of Kansas showing sowing stations of the last four years. (The territory represented is 400 miles long by 200 miles wide.) C = Theoretic date of safe-sowing figured according to "Hopkins' Law of Latitude and Altitude" from Columbus, Ohio. M = Theoretic date of safe-sowing figured according to "Hopkins' Law of Latitude and Altitude" from Marysville, Kansas. • = Location of sowings and average date of safe-sowing as determined from experimental sowings.

...ations, but since that time, the stations have been secured and ...aged by the Kansas State Experiment Station, representatives ... Bureau taking such data as they desire. Taking the experi...tally-determined safe-sowing date of Marysville (latitude 39° 49′, ...ude 1153 ft.) as October second, the theoretic safe-sowing dates ... Manhattan (latitude 39° 11′, altitude 1012 ft.), Sedgwick (latitude ... 56′, altitude 1375 ft.), and Caldwell (latitude 37° 1′, altitude ...7 ft.) for which we have the averages of two or more years of ...ings, are October 6, October 7, October 13, respectively, while the ...ual dates determined by the average of two or more years of experi...ental sowing are October 7, October 9, and October 14. Likewise ...king the experimentally determined safe-sowing date of Great Bend (latitude 38° 22′, altitude 1843 ft.) (in the western series where only two stations have as yet given promising results) as October 5, the theoretic date for Sawyer (latitude 37° 29′, altitude 1913 ft.) would be October 8, while the actual date by one year's test is October 7.

The correspondence between theoretic and actual date is close enough that Hopkins' law may be said to apply to the eastern series and western series when considered as separate units. Here, as in the case of Ohio and West Virginia, the only factor of climate sufficiently variable within the limits of the individual series to produce such variation in time of safe-sowing in relation to latitude and altitude is temperature.

For the purpose of further testing the universality of this law, let us take the date of safe-sowing at Marysville as October 2. Applying the law, the theoretic date of Great Bend (latitude 38° 22′, altitude 1843 ft.) is found to be October 1, whereas two years sowing tests shows the actual date to be October 5. No such discrepancy as this appeared between the actual and theoretic dates in Ohio and West Virginia according to Hopkins. For the purpose of further testing the law, taking the safe-sowing date at Columbus (latitude 40°, altitude 800 ft.) experimentally determined as September 25, we find that the theoretic safe-sowing dates for Marysville and Great Bend are September 23 and September 21 respectively, whereas the actual dates by experimental sowings are October 2 and October 5 respectively. The actual date at Marysville is 9 days and at Great Bend 14 days later than the theoretic. Evidently, this difference is the indication of another powerful factor.

When we review the factors of environment known to retard Hessian fly which do not vary enough to produce a material difference in Ohio and West Virginia, or in the individual stations of either the eastern or western series, but which do vary enough to make large

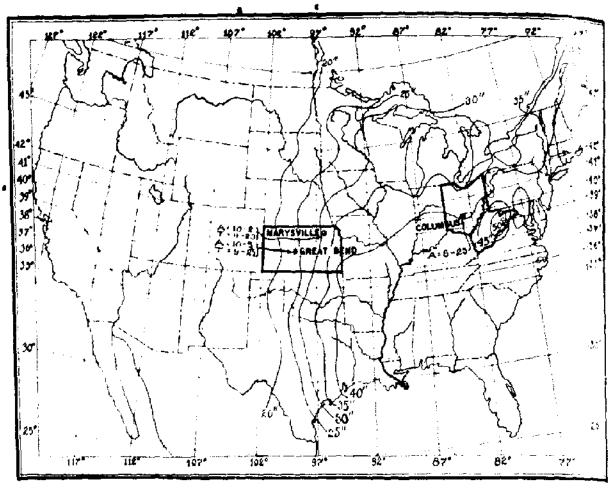


Fig. 2. Map of the United States showing the discrepancy between the theor
and actual date of safe-sowing in relation to normal annual precipitation. A = Act
date of safe-sowing as determined by sowing experiments. T = Theoretic date
safe-sowing figured according to "Hopkins' Law of Latitude and Altitude"
the actual date of Columbus.

differences between Ohio and the eastern Kansas series and betwe the eastern and western Kansas series, moisture stands out alo The following table well serves to bring out the existence of a rat between the difference existing between theoretic and actual date of safe-sowing and the difference in normal annual precipitation. The ratio appears to be about one day to the inch—one day earlier if one inch greater and one day later if one inch less.

CORRELATION BETWEEN SAFE-SOWING DATE AND NORMAL ANNUAL PRECIPITATION

Place	Actually determined safe-sowing date	Theoretic safe-sowing date, taking Columbus as Sept. 25	Difference between actual and theoretic safe-sowing date	Normal annual precipitation
Columbus, Ohio	Sept. 25	....	....	40 in.
Marysville, Kans.	October 2	Sept. 23	9 days	30 in.
Great Bend, Kans	October 5	Sept. 21	14 days	25 in.

Of course, it is quite probable that this ratio between normal annual precipitation and the date of safe-sowing may not hold where the precipitation reaches more than forty inches, but it is evident that it must be taken into consideration when the rainfall is forty inches or less. Hopkins' law of latitude and altitude must be modified to include the operation of moisture as well as of temperature.

Even after the entomologist has by means of experimental sowings determined the normal date of safe-sowing in his territory, his work is not done, for there have been and will be cases when for lack of moisture or something else, the fly will be retarded, and, coming out late, infest the wheat sown on the safe-sowing date just as seriously or more seriously than sowings made either before or after. To avoid this, the entomologist should adopt as the normal safe-sowing date the average of dates on which the sowings of several years have been found absolutely free from fly and should, when an outbreak is anticipated, keep a close watch on fly emergence. The date of safe-sowing as shown in the following table follows within a day or two the maximum emergence of the fly.

RELATION OF MAXIMUM EMERGENCE TO DATE OF SAFE-SOWING

Place	Date of maximum emergence	Date of fly-free sowing	Difference
[illegible]	10 10 '08	10 12 '08	[illegible]
[illegible] Kans.	10 4 '08	10 5 '08	[illegible]

The field men can thus check up the progress of emergence and warn the grower if the normal fly-free date is likely to prove too early or materially later than necessary.

PRESIDENT F. L. WASHBURN: Any discussion of this paper?

F. M. WEBSTER: The results of Doctor Headlee's investigations are really not so surprising, but as a matter of fact, the exact influence of humidity on Hessian fly has never before been so thoroughly investigated. There is a vast difference between the country east of the Mississippi river and that west of it. There is a difference between the humidity of eastern Kansas and that of western Kansas, so that Doctor Headlee has a grand opportunity to study this problem. I do not know of any state in the union that offers the same conditions. While the data he has given from Ohio is not that for which I am responsible, nevertheless I think that he has done a most excellent and creditable piece of work, and I see no reason whatever for criticizing the accuracy of the results as given. As a matter of fact, we have a

modification of these conditions in southern Michigan and n... western Ohio. The influences of Lake Michigan and Lake Erie ... a very considerable influence on the appearance of the fall bro... Hessian fly. As a matter of fact, the farmer in Michigan, as far n... as Lansing at least, can sow his wheat no earlier than can the fa... a considerable distance south of the Ohio line.

We have on record results of wheat sowings made in northern N... York in co-operation with the New York Experiment Station, so... ward into South Carolina, where we worked in co-operation with ... Agricultural Experiment Station at Clemson College. West of ... Alleghany mountains we have the record of a series of wheat sowings made in extreme northern Michigan where Hessian fly does not occur, southward to central Georgia where our experiments were carried out in co-operation with the state entomologist. Besides these we have a vast amount of information obtained by myself and the men working under my direction throughout northern Indiana.

This mass of material is awaiting the completion of some other work on this species before being published. Not only do I think Doctor Headlee correct in his statements, but I would even go farther and strongly suggest that the absence of Hessian fly in some parts of the country is due to these same influences.

When Hessian fly was destructively abundant at Great Bend, Kansas, it required an expert to detect its presence at Dodge City where wheat is grown throughout and beyond this area and has been for the last 25 or 30 years. When wheat is ruined by Hessian fly in Sumner County, southern Kansas, 20 miles south of Arkansas river in Oklahoma, a good entomologist may find one or two individuals for each hour's search.

There is a great deal of work to be done on this problem, and while government entomologists can work over an area embracing a half dozen states, we do not have either the time or the men to work out problems as carefully within the boundaries of a single state as Doctor Headlee is able to do.

There is another point that always presents itself in connection with these Hessian fly problems. The effect of rainfall on the emergence of Hessian fly in autumn is pretty well known, but there are so many other factors entering into the problem of evading Hessian fly attack that the farmer gets befuddled and is likely to disregard all, or a great deal, of advice given him. A good farmer will often raise a crop of wheat side by side with a neighbor who loses his by Hessian fly attack, so that there comes a point where the question ceases to be an entomological one and becomes strictly agricultural.

Another thing, in the East we never find Hessian fly breeding in

In Kansas I have found it developing as abundantly on ...on *smithii* as upon wheat.

... HEADLEE: I realize that the amount of data, on which the ...oint that I have to present is based, is so limited that the point ...argely be taken as in the nature of a suggestion. I would, ...er, say that I have some negative data that I am not submitting ...s paper.

... D. HOPKINS: Mr. Chairman, it is naturally very gratifying to ... this verification of my theory on this subject. I might state ... in Bulletin No. 67 of the West Virginia Agricultural Experiment Station, August 1900, entitled, "The Hessian Fly in West Virginia and How to Prevent Losses from its Ravages," I discussed the theory on pages 242 to 246, under the head of "A Law of Definite Normal Rate of Difference in the Periodical Phenomena of Plants and Animals." I will read the three paragraphs in which the essential features of the theory are specified.

"First, that, under similar conditions of land surfaces other than altitude, there is a definite normal rate of difference in time in periodical phenomena of plants and animals for all differences in latitude and altitude.

Second, that, under normal conditions, the rate of the average difference in the dates of the beginning or ending of such phenomena ... not far from one day for each fifteen minutes of latitude, and one day for each 100 feet of altitude.

Third, that the dates of commencing or ending of a given period ...ary with the season,—the weather and local physical conditions, ...ch as exposure and character of soil,—but that the rate of difference under each condition is the same."

This is founded on evidence furnished by natural phenomena which ...n be observed by any one and which reflect the combined influences ... numerous and complex elements exert on plants and animals, such ... temperature, humidity, character of soil, exposure, and a number of ...er factors. The relative difference in any given phenomenon is ...emonstrated by the relative activity of plants and animals in the ...ring. When activity begins in any given locality, as for example ... opening of the buds, it will do so under the influence of the com...ation of factors prevailing there.

...herefore, if we note, in any given season, the appearance of a ...nomenon at any given place, we can prophesy within a few days ...hen the same phenomenon will occur at another place, north or ...h or east or west at varying altitudes, if we know the latitude and ...ude. I have verified this over and over again. I have much ... from Maine to Florida and from Washington to the high moun-

tains of West Virginia, secured on railroad trips, which all te[illegible] show that there is a principle here which can be utilized and [illegible] has a broad practical application, not only in the control of i[illegible] the study of life histories of insects, but for the planning of farm [illegible] ations.

The fact of it is, farmers have recognized and utilized the pri[illegible] I remember when I was a boy that the farmers in the comm[illegible] where I was reared planted their corn when the dogwood was in [illegible] and the new leaves on the white oak were the size of squirre[illegible] They had determined, from long experience, that, when the corn planted at that time, they had the best results. The dogwoo[illegible] the white oak served as the index. Therefore, we have, all th[illegible] the country, every spring, similar indexes which can be recog[illegible] and utilized as guides to the proper time to do things. During present year we conducted extensive demonstrations in the co[illegible] of barkbeetles over quite a large area in northeastern Oregon. [illegible] area is practically in the same latitude, but there is quite a differ[illegible] in altitude. Now, our normal period for the ending of control op[illegible] tions is July 1st, because after that date, under average conditi[illegible] the beetles begin to emerge from the trees. So we stopped operati[illegible] on July 1st, but I kept one of the Agents there to make contin[illegible] observations until in August. He found that, while July 1st was [illegible] proper date to cease operations at about 4,000 feet because at [illegible] date the beetles were emerging and attacking other trees, at 3[illegible] feet higher up in the mountains it was just thirty days later w[illegible] they were emerging and attacking the trees. Therefore, cont[illegible] operations could have been continued thirty days longer if we [illegible] acted on that principle. Farther south here, of course, we wo[illegible] have had to discontinue the work much earlier. This is simply [illegible] example of the practical application of the principle.

President F. L. Washburn: Anything further on this very in[illegible] esting and practical subject?

T. J. Headlee: Mr. Chairman, I realize that in some branche[illegible] our science there is too much of a tendency to theorize on a s[illegible] amount of data, and that is vicious, but, at the same time, in [illegible] economic entomological work, I have come to feel that there is [illegible] enough theorizing,—that we work, perhaps, too long, on one su[illegible] before we say anything about it. The result of that method is [illegible] that the younger men who are ready and eager to take up these im[illegible] tant subjects are not stimulated to do so. It seems to me, i[illegible] older men in these lines of work would, from time to time, set [illegible] tentatively results that they have obtained, they would stimu[illegible] vast amount of work along their lines and that, in the aggregat[illegible]

...cumulate knowledge more rapidly than by the methods we ... using. I realize, of course, the danger of doing too much ...ng. I should say that it would be very unwise to publish ...peculations in our bulletins, except probably the technical ...s, but that to furnish them to our journals, which are for ...ologists only, might materially advance our science.

P...SIDENT F. L. WASHBURN: The next paper will be read by ... R. I. Smith.

THE CORN BILL BUG (SPHENOPHORUS CALLOSUS

By R. E. SMITH, *West Raleigh, N. C.*

(*Withdrawn for publication elsewhere.*)

PRESIDENT F. L. WASHBURN: Any discussion of this paper by ... Smith?

... J. HEADLEE: I would like to ask Doctor Smith whether, in ... course of his breeding work, he took into consideration the effects ... temperature and moisture?

R. I. SMITH: I have kept no records of that, but anticipated that, ...working up the results, I would have access to the Weather Bureau ...ords, which were kept within a mile and a half of where I worked, ...st Raleigh, North Carolina. I didn't keep any records myself. I ... at the time that question was coming up, and they ought to have ... kept, but I wasn't in a position to do it.

... M. WEBSTER: With reference to Mr. Smith's paper, I would ... call attention to the fact that *Sphenophorus callosus* is naturally ... swamp inhabiting insect. Moisture appears to be an important ...tor in its development, as we find it destructive almost, if not ...rely, in the lowlands.

We, of course, knew that Mr. Smith was working on this problem ... as ourselves, so that we have worked together as best we could. ... difference in the situation under which Mr. Smith worked and ... which we were working is this, that while very much of his ... was necessity carried on indoors, our investigations have ... almost without exception, carried out in the fields. For this ...on, we did not think best to withhold the results of our investiga... for publication until we had gone over the same ground covered ... Mr. Smith. Our publication went to press some time ago, and I ... on the spur of the moment recall all of the matter it contains. ... I do not think that where our work has overlapped there is any ...erial difference between the results obtained.

...re is one point with reference to this species that is too interesting

in view of what was said yesterday with reference to priority. We have here a case where the perfect insect has never been described. The term "callosus" means rubbed, and refers to the rubbed or callused spaces on the back where the velvety covering has been rubbed off. Beetles taken directly from the cells in which they have developed are covered entirely with a reddish brown coating, which under the microscope has a velvety appearance.

Now if the perfect insects were to be described, the description would be rejected, and that of the imperfect individual retained solely on the score of priority.

R. I. SMITH: Mr. President, allow me to say this. Professor Webster just stated that my work had to be carried on in a room about twelve feet square, with wire on all sides, and just the roof to protect me from the sun, and I tell you it was pretty hot down there this summer, about 102 in the shade for a month or two. But it seems to me that, under those conditions, it was as near field conditions as possible and still have the work in the laboratory where we could manage it. Of course, I couldn't get any such accumulation of records in the field as he did. My laboratory afforded perfect circulation, and air and moisture conditions were as near field conditions as possible. I didn't want to take the time, but Professor Webster said that he had forgotten what was in his paper, and as he handed me a copy of it to look over there are one or two points I wanted to tell Professor Webster, and if he wishes I will tell them publicly.

F. M. WEBSTER: Go ahead.

R. I. SMITH: One statement that I noticed in your paper was in regard to the variation in the size of the eggs, and you stated there was great variation, which, of course, I found out from measurements, and you stated that your men thought the variation was due partly to enlargement of the egg before hatching. I found nothing of the sort this summer. Possibly my records for larval development being much longer were because of being under abnormal conditions.

E. A. SCHWARZ: The name of *Sphenophorus callosus* has manifestly been derived from the peculiar structure of the pronotum. In many of the genera allied to Sphenophorus two forms occur:—one, being covered with a more or less evident pruinosity and the other without this pruinosity. This can be most readily seen in our common palm weevil of Florida, *Rhynchophorus cruentatus*, but the form without the pruinosity cannot be called abraided. In some of our species of Sphenophorus the pruinosity is much more pronounced and acquires the nature of an argillaceous coating, but even this is more or less absent in many specimens. Regarding the flight of Sphenophorus I have seen *S. costipennis* flying in great numbers along the riv[illegible]

in Michigan, in the early spring of the year. Further, I have seen *S. parvulus* in great numbers attracted by the white walls of the ...ol in Washington, where they had flown from the surrounding ...y lawn; *S. ochreus* was seen by Mr. Hubbard and myself flying in great numbers on July 4th on the shores of Great Salt Lake, ... and finally every visitor to Florida can see hundreds of specimens of *Rhynchophorus cruentatus* flying about in the evening of any warm summer day.

PRESIDENT F. L. WASHBURN: Anything else to be said on this paper?

The next paper on the programme is by the chair, on "Grasshopper Work in Minnesota." Doctor Ball will you take the chair?

GRASSHOPPER WORK IN MINNESOTA DURING THE SEASON OF 1911

By F. L. WASHBURN, *Experiment Station, University of Minnesota, Minnesota.*

In the western third and half of the southern part of Minnesota grasshoppers of various species have been increasing to such an extent that serious losses have been occasioned. It is not to be understood that the entire grain output of Minnesota has been materially lessened by the ravages of these pests, although in 1910 it was estimated that two-thirds of the flax crop was destroyed, but individual farmers living in the districts above specified lost from 20% to 90% of their crops, and in some cases their entire crop of grain was destroyed. All grains have suffered, as well as timothy, corn, young trees in nursery row, garden products, and particularly flax.

The greatest destruction has, in every case, been in proximity to large tracts of land which have been, perhaps, in tillage some years ago, and have been allowed to revert to natural conditions. Such tracts are the direct cause of all the trouble which we have experienced. It is true we have in Minnesota a grasshopper law which, supposedly, effects the plowing of such dangerous land when infested with grasshopper eggs, but, as a matter of fact, the law is ineffective through faulty wording, and it is utterly impossible for counties to plow this land. For instance, in one township alone in a western county we know of at least 8,000 acres of land which calls for the plow and does not get it. Through the ineffectiveness of this law the owner cannot be forced to plow, and at the rate of $2.50 an acre it would cost this county over $16,000 to take care of reverted land in this single township.

Conditions became so serious in this state that the entomologist

secured an appropriation of a few thousand dollars for two years' work in an effort to discover the best method of controlling this pest. With this money four men were paid to be in the field all of last summer. The work of these men was largely directed by Mr. M. P. Somes, of Iowa, and under his oversight a large amount of work has already been accomplished. The efforts of these field workers were directed along certain definite lines. Headquarters were established at Fergus Falls in the Red River Valley, and there, through the courtesy of city officials, we were given a laboratory, and also secured from the city a piece of land for experimentation.

The laboratory work consisted largely of breeding, studying the moults and the raising of parasites, and upon our experimental grounds we planted grain crops to test thereon the efficacy and safety of a poison spray to be referred to later. We also secured the co-operation of many farmers of intelligence in the matter of this spraying.

An important feature of the work, and one which took almost the entire time of the leader, and also a large share of the time of one of the other workers, consisted in answering calls of individual farmers who needed advice or encouragement or both. This has taken much time and much money, as one will readily realize, and we have determined that another season this part of the work would have to be discontinued. We are willing to meet and discuss the question with groups of farmers, when such meetings are called for this purpose, but we found that often farmers who had no special occasion for our help, summoned us frequently, although quite indifferent to what we had to say and to our advice. This was not, by any means, always the case, and I believe that, in spite of the large expense occasioned by this variety of work, much good was accomplished by our individual visits.

The attitude of the farmers and citizens generally was one of interest and showed a co-operative spirit, at the same time many instances were met with which were discouraging. This, I believe, is particularly true among those renting farms, who took the attitude that it was not worth while to make any effort, or that, perhaps, the grasshoppers would not be so bad another year, or, they were leaving to go to, what seemed to them, more promising fields, or they doubted the efficacy of the treatment advised, or they thought, some at least, that the state should bear all expense in treating individual farms. We found some criticism and lack of sympathy on the part of real estate dealers, who felt that their business interests were being interfered with by what looked to them like undesirable advertising. In one case, reported upon by Mr. Somes, where a hopperdozer with its victims was displayed in a public street, to show the efficacy of this

...ment, interested and misguided citizens ordered the machine ... dead hoppers to be removed.

...out seventy-nine Orthopterous species were collected and named ... the summer's work, which must not be regarded as representing ... entire Orthopterous fauna. Of these species, as you will readily ... gine, only a comparative few were strikingly injurious, namely, *M... aplus bivittatus*, *M. atlanis*, *M. femur-rubrum* and *M. differ...tis*, to which harmful species we may possibly add *Stenobothrus ...pennis*, and, to a lesser extent, *Camnula pellucida*.

A note-worthy fact in connection with our operations this year is the extreme abundance of *M. bivittatus*, which easily led in numbers of individuals in almost the entire tract referred to above. From being secondary in economic importance three years ago, it has taken the lead this year as being the most abundant of injurious forms. As a fact accessory to the abundance of grasshoppers in Minnesota the past three years, and particularly the past two years, it is to be remarked that two Meloid beetles, *Macrobasis unicolor* and *Epicauta pennsylvanica*, were extremely abundant and injurious in our state during the early part of the summer. Mr. Somes ascribed the abundance of these beetles this year to the abundance of grasshoppers in the preceding year, and I believe his theory in this connection is a good one.

While experimenting with a poison spray we have at the same time urged farmers to use the old-time hopperdozer, personally showing them in many cases how to make the same, and have also been advocating late fall plowing, poison baits in gardens, but particularly to protect the latter, the placing of flocks of turkeys, which not only have an insatiable appetite, as you know, for grasshoppers, but are a profitable adjunct upon any farm. Many farmers believe that a grasshopper striking the drenched sheet at the back of the hopperdozer, or falling into the pan and then getting out, is not killed, and we have been in the habit of assuring them that the slightest drop of oil upon an insect of this kind will kill, and that each one of these grasshoppers is doomed. Mr. Somes' observation this summer would seem to indicate that that statement must also be qualified, and that it must be acknowledged that although short-winged forms or wingless stages that are wet with the oil undoubtedly perish, inasmuch as the oil reaches the spiracles, many long winged forms do not die because of the protection to the spiracles afforded by the wings.

We have not advised the burning over of fields alive with young hoppers, believing the same to be dangerous and of questionable utility in a country where a hay crop is an important feature. We encourage co-operation, and we have especially advised action against

grasshoppers, and vigorous action, when they first appear, even if it interferes with other farm work, for we find that whatever plan we follow as regards this pest, that they are much more easily handled, as would be expected, when they are young, than when they have developed their wings.

Our field workers reported only partial success with poison baits, represented by poison bran mash and Criddle mixture, but have, in the course of their work, hit upon a rather unique poison, which they have courteously called the "Minnesota mixture." Finding that arsenite of soda used as a spray, and combined with a little molasses, was very effective against grasshoppers, they substituted this for the Paris green used in making the Criddle mixture. They used the following formula:

Sodium arsenite 1 pound; horse manure 120 to 150 pounds; cheap molasses 1 pint. The arsenite of soda was dissolved in the water then added to the manure, stirring it well.

This is cheaper than the Criddle mixture and can be used in the same way. It forms a very attractive bait for grasshoppers. It was tested upon poultry to see whether these animals, in picking grain from such material, would be injured. Two roosters were fed upon it for some time with no bad results. Incidentally, it may be said that flies are attracted to this mixture in enormous quantities, and are killed by the hundreds in feeding upon it. After this mixture had been exposed for a day in the experiment with the roosters over a quart of dead flies was found on the floor of the shed containing the poultry. This observation might be of value to those who are making a fight against the house fly, and it has been suggested that spraying piles of horse manure exposed in barns and livery stables with a solution of eight ounces of sodium arsenite in about twenty gallons of water, to which has been added about a half pint of molasses, would be a useful measure against the house fly.

Our most prominent work has been done with a poison spray. Aware of the success of arsenite of soda used as a spray in South Africa, I determined to try it in Minnesota, thinking its use might be applicable to large tracts in the Red River Valley which call for treatment. Without going into the details of our experiments in this line, both on a small scale and over large areas, I wish to say that we have been more than pleased with the results, and firmly believe that if made properly and used in the right way, it is our most efficacious means of keeping down the numbers of these pests, which will always be more or less troublesome in the newer, less cultivated districts. We found that 3 pounds of commercial arsenite of soda; 1 ½ gallons of molasses in 180 gallons of water, made a mixture which was fatal to hoppers

...d not in any way injure crops. We used, in most of our experi-... field sprayers which covered 23 feet at one time. We used ...oximately 50 gallons per acre, at a cost of about 30c, this estimate ... upon the retail price of arsenite, namely, 22c per pound. The ...on of the water supply is an important feature in the cost of .... Further, we believe that when vegetation is quite rank an ... would call for something more than 50 gallons. This poison did ... kill immediately, from 24 to 36 hours elapsing before the insect ... up the ghost, but it is to be noted that a partial paralysis was ... immediate result of partaking of the poison. The insect was immediately made sick and ate nothing.

We received from various farmers of intelligence congratulations upon this method, and statements of their success in using it.

Of course, the question at once occurs to the practical farmer as to whether this is dangerous to stock. We have made tests along this line, and while it must be remembered that any poison is detrimental and frequently fatal if taken in too large amounts, we *feel convinced* from our experiments, that, as ordinarly used by a farmer bearing the above fact in mind, no bad results will happen. A Holstein bull was fed with forage poisoned with this spray in the above proportions, being fed about 15 pounds of this each day for ten days, and showed absolutely no symptoms of poisoning. On the other hand we observed unpleasant symptoms in a young heifer fed with the same kind of forage, and later, when this same animal was turned upon a grass plot, where the grass has been drenched with poison applied, (through an error of an assistant), three times as copiously as it should have been, after eating ravenously of this over-poisoned forage, rapidly developed symptoms of arsenical poisoning and died. As you will readily see, these conditions would never arise in actual farm practice.

As regards fall plowing it is possible that we will have to qualify ...commendations in that connection, and the advice that we have given to this end in years gone by may represent an example of the general acceptance and promulgation of certain remedies, the thor-...ghness of which has not been properly tested.

In the first place, farmers for the most part will not plow in the ... fall. They have large tracts of land to handle, and, as a rule, ... that they must begin their plowing immediately after the crop ... off the ground. This is before egg-laying takes place. Our field ...nt, Mr. Somes, doubts the efficacy of the plow unless it is followed ... the harrow. He claims that more real good results from cultivation ... a harrow, since that has a tendency to break up the egg masses ... expose the eggs to the effects of bleaching and drying, and render-... them more easily accessible to their natural enemies. He further

claims that at the time the young hatch the enveloping capsules become soft and jelly-like, and that the young grasshopper may easily push up through that toward the surface in cases where the capsules are inverted by the plow. He further does not believe that the alternate freezing and thawing of the eggs causes the death of the same, since, being close to the surface, they must be subjected to this in Minnesota every season. He has further exposed to alternate freezing and thawing this winter newly hatched grasshoppers, twenty, according to his report, having been frozen and thawed twice with no mortality, except in the case of one individual, which probably perished through rough handling. In spite of his belief, as here cited, I still hold that turning the eggs under deeply must materially lessen the number of grasshoppers which would naturally emerge the following season, and, plowing being in accord with farm practice, I shall continue to recommend it until we know of something better.

Under the head of Natural Enemies I have not listed all of the known predaceous insects or vertebrates known to attack and destroy grasshoppers, they are all very well known, I am simply citing certain findings of our own during the summer just passed.

I have always held that *Trombidium*, the so-called red mite, does no serious injury to the grasshopper when fastened to its wings and other parts of its body, or, at any rate, we have observed grasshoppers loaded with mites, ovipositing so frequently that we are convinced there is no material lessening of their numbers through the attacks of the mites upon the adults. But the adult mite in the spring, has been seen to actually feed on the eggs of the grasshopper, and wherever grasshopper eggs are found in abundance my men found there also the red mite very abundant. Small larvæ were found in the vicinity of egg masses by Mr. Somes, which were not reared, but which were believed to be Meloids, and possibly belonging to the genus *Epicauta*. Two flies were reared from Melanopli in our laboratory at Fergus Falls, *Muscinus stabulans*, which was distinctively parasitic with us, and the Sarcophagid, *Helicobia helicis*. This latter fly may have been a scavenger in connection with our work. Mr. Somes also reports the presence within grasshoppers of what appears to be a Syrphid larva. This died before being reared to maturity. Hairs worms were found in abundance in the bodies of *M. bivitattus* and *M. differentialis*. Many predaceous beetles of the genera *Harpalus*, *Pterostichus*, *Calosoma*, *Amara* and *Pasimachus* were observed feeding upon the adult and eggs. Several different genera of Asilid flies were observed attacking various species of grasshoppers in the field.

Among vertebrates that prey upon grasshoppers in Minnesota we have a wonderful ally in the black tern, which, in flying over the grain

... and grass lands in the prairie country, consumes a large number of grasshoppers. In two cases, in two different localities farmers stated that these birds practically saved their crops. In both cases the farms were located in a marshy area, and during the period in summer when the marshes are dry the terns naturally turn to the feed afforded by the grain fields and meadows.

The following Orthopterous species were collected and named:

Tettix granulatus
Tettix granulatus var. variegatus
Tettix hancocki
Tettix obscurus
Paratettix cucullatus
Tettigidea parvipennis
Neotettix tricarinatus
Orphulella speciosa
Dichromorpha viridis
Chloealtis conspersa
Stenobothrus curtipennis
Gomphocerus clepsydra
Ageneotettix scudderi
Opeia obscura
Mecostethus lineatus
Arphia arcta
Arphia (tenebrosa) pseudonietana
Arphia carinata
Chortophaga viridifasciata
Encoptolophus sordidus
Camnula pellucida
Hippiscus tuberculatus
Hippiscus rugosus
Hippiscus zapotecus
Dissosteira carolina
Spharagemon aequale
Spharagemon collare
Spharagemon wyomingianum
Mestobregma cinctum
Psinidia fenestralis
Trachyrhachis verruculatus
Pseudopomala brachyptera
Hypochlora alba
Hesperotettix pratensis
Hesperotettix speciosus
Schistocerca alutacea
Melanoplus scudderi
Melanoplus dawsoni
Melanoplus blatchleyi
Melanoplus atlanis
Melanoplus spretus
Melanoplus femur rubrum
Melanoplus gladstoni
Melanoplus extremus
Melanoplus angustipennis
Melanoplus packardii
Melanoplus luridus
Melanoplus collinus
Melanoplus differentialis
Melanoplus infantilis
Melanoplus femoratus
Melanoplus bivittatus
Melanoplus minor
Phoetaliotes nebrascensis
Scudderia curvicauda
Scudderia furcata
Amblycorypha oblongifolia
Conocephalus ensiger
Conocephalus nebrascensis
Orchelimum glaberrimum
Orchelimum longipenne
Orchelimum nigripes
Xiphidium fasciatum
Xiphidium saltans
Xiphidium nigripleurum
Xiphidium strictum
Xiphidium brevipenne
Xiphidium ensiferum
Ceuthophilus blatchleyi
Ceuthophilus devius
Nemobius fasciatus
Nemobius canus
Nemobius carolinus
Gryllus pennsylvanicus
Gryllus abbreviatus
Oecanthus fasciatus
Oecanthus quadripunctatus
Oecanthus niveus
Anaxipha exigua

We are indebted to Lawrence Bruner and members of his staff for assistance in identifying eight of the above species.

You will note in the above list that Mr. Somes collected and named one *M. spretus*, which I brought with me for your examination. It has the ear-marks of the so-called species *spretus*, and yet in looking at the genital plates I am inclined to think it resembles *atlanis* in this particular as much as it does *spretus*. At any rate the finding of this one isolated example in the midst of so many other species, *atlanis* among the rest, throws doubt upon the validity of *spretus* as a species.

The advantages of spraying early with arsenite of soda are as follows:

1. The grain is short and, therefore, more easily covered.

2. The hoppers are still in masses, hence greater effect with a small amount of poison is secured than later when they are scattered. The young hoppers travel more slowly and must eat continuously while in the poison zone.

3. Large fields, therefore, can be protected by spraying relatively few acres on edges of larger tracts. We found that wild mustard growing amongst the grain was badly burned by the spray, although the grain itself was uninjured.

The efficacy of this spraying is shown by the fact that after one application 2½ bushels of dead hoppers were gathered from one acre of a field twenty-two acres in extent. This would mean over fifty bushels of dead hoppers in that field.

This spray did fine work on flax, one man's crop being saved, whereas that of his neighbor in the near vicinity, who did not spray, was a total loss.

In Minnesota we feel that the best time to spray is between May 15th and June 15th—practically the same period as advised for the use of hopperdozers. Hopperdozers used by the farmers cost from $5 to $8 for the 16 foot size, and we purchased a cheap grade of oil varying from 7c to 10c a gallon at the supply tanks.

A MEMBER: Do you find that your farmers out there invest readily in the spraying machines?

F. L. WASHBURN: They will doubtless do so next summer. That is, a number of them may go in together. These machines cost in the neighborhood of $90, but a large number of farmers are convinced of the value of the spray and will probably invest.

H. A. SURFACE: I should like to ask the speaker if he finds the spike tooth harrow reaches sufficiently deep to break up the pupa and egg cases or if he thinks the spring tooth harrow necessary.

F. L. WASHBURN: I think the disk harrow is more commonly used there. I should suppose the spike tooth harrow would do it more thoroughly, perhaps, than the disk harrow.

H. A. SURFACE: Do you think a spike tooth harrow would be deep enough to do the work?

.. WASHBURN: Well, you want to get down two or three inches, you, about that? I should think it might do.

J. HEADLEE: Mr. Chairman; I desire to comment a little on subject, basing my remarks on work carried on in this line in Western Kansas last summer. We found the same injurious species Mr. Washburn describes in Minnesota. We experienced so much trouble with the canvas back of the hopperdozer through the hoppers catching hold of the cloth and springing away unharmed, that we substituted oil cloth with the slick side toward the pan. We tested Criddle mixture, bran mash and the sodium arsenite spray. Our problem was mainly one of preventing the hoppers from moving from native pastures or freshly cut alfalfa into adjacent cultivated fields. For this purpose we find the poisoned bran mash broadcasted each morning over a protective strip along the edge of the field most satisfactory. Criddle mixture prepared by the usual formula was relatively unsatisfactory. Poisoned bran mash, made by mixing 20 pounds of bran dry with one pound of Paris green and bringing the poisoned bran to a stiff mash by adding three and one half gallons of water to which the juice and pulp of three or four oranges finely chopped have been added, has proven more satisfactory than that made according to the usual formula. The poisonous spray at the strength used by the Central South African Locust Bureau killed the hoppers but was unsatisfactory because when dissolved by showers it very seriously damaged the vegetation on which it had been placed.

F. L. WASHBURN: What strength was that, Mr. Headlee?

T. J. HEADLEE: That is the strength recommended by the Central South African people.

F. L. WASHBURN: We found that under no conditions did we injure the grain as we used it.

T. J. HEADLEE: I think that is a very important discovery.

A MEMBER: I noticed, Mr. Chairman, that you stated it was not necessary to spray the whole field, but that you do "checker board" spraying.

F. L. WASHBURN: That is when the hoppers are young and they bound to get on to it. Small checker work, you understand, a big square.

A MEMBER: You spray then what percentage of the actual field?

F. L. WASHBURN: Possibly not more than twenty-five per cent.

M. H. SWENK: Mr. Chairman, I note on the programme that Professor Bruner is down for a discussion on this subject, and he expected to be present, but events transpired that prevented, and I take this opportunity to express his regrets in the matter and extend greetings to you.

The conditions that Professor Washburn explains for Minnesota were largely the conditions which obtained in eastern Nebraska this year, with the exception, however, that one species greatly predominated, and that species was the one which he finds only in the southern part of Minnesota. In eastern Nebraska,—I mean by that the eastern one-third of the State this species occurred in the cultivated fields almost to the exclusion of the other species. In the corn fields, perhaps one specimen in five would be either *Melanoplus femur-rubrum* or *M. bivittatus*, but no more than that, and of these two *femur-rubrum* was the more abundant. We, therefore, have the unusual condition that, so far as eastern Nebraska is concerned, we have but one species to fight, and that is *differentialis*. This species occurred, however, in tremendous numbers in some portions of the State of Nebraska, and a great deal smaller crops were obtained because of the the presence of that insect. I happen to have with me a couple of very poor prints which will show something of the injury. One of these I want to pass around. It shows a photograph of a very poorly kept orchard. That is perhaps the reason the hoppers abounded there. But this photograph was taken the latter part of July, and the trees had been entirely defoliated, while the grasshoppers even got to eating the bark off the trees until large strips on the branches were denuded of their bark as well as of the leaves. Now, in western Nebraska, we found that instead of three species, at least fifteen species occurred in the cultivated fields, and of these, at least six occurred in destructive numbers. But there it was *bivittatus* which predominated. In the more southern counties *differentialis* was very abundant, *atlanis* was also very abundant and *femur-rubrum* was abundant in the lower valleys. In addition to these, we had several other species of which there was untold numbers coming into the cultivated valleys from the adjacent or surrounding hills. These hills have never been cultivated, and the acreage so greatly exceeds the acreage of cultivated lands that there is no way which has occurred to us in which to solve the problem of getting rid of these pests. The use of the hopperdozer, the use of nearly all the poisons which we could think of, and even cultural methods, have no apparent effect upon the hordes of grasshoppers, principally *bivittatus*, breeding in this higher land and coming down into the valleys as they grow older.

We noted, in Nebraska, the same conditions of an abundance of blister beetles. In fact, one farmers' convention, called together for the purpose of discussing the grasshopper plague, partially resolved itself into a convention for the discussion of blister beetles, especially when several farmers stated that they had lost their entire crop of potatoes from this cause. The predominating species there was the

...striped species, and this did great injury in certain parts of the ... in alfalfa fields, occurring there in swarms and extending over ...re rods until the alfalfa was simply loaded down with them, and ...often destroyed large portions of the field. Westward, the spotted ...es and one other predominated. We found the conditions very ...ar to those described by Professor Washburn. We have not experimented as yet with the sodium-arsenite treatment. We shall do that next year. But we did work very thoroughly with poisoned bran mash, using Paris green as the arsenical constituent, and found it very satisfactory in most cases.

GRASSHOPPER CONDITIONS IN COLORADO

By C. P. Gillette

This paper is in no true sense a discussion of the paper by Professor Washburn but rather a companion article setting forth the grasshopper conditions in Colorado.

During the summer of 1910, northern Colorado experienced the worst grasshopper outbreak that I have witnessed since coming to the State over twenty years ago. The grasshoppers that were most abundant were, *Melanoplus bivittatus*, *M. differentialis*, *M. atlanis* and *M. femur-rubrum*, and in about the order named. It was the first year that I have ever known *differentialis* to be as abundant in northern Colorado as *bivittatus*, which is nearly always our most destructive species.

The crops suffering most from the attacks of grasshoppers in Colorado have been alfalfa, grain crops, sugar beets, potatoes, and garden crops. There is no doubt but what the injury to the alfalfa exceeds that of all of the other crops combined. It is common for the farmers in northern Colorado to cut three crops of alfalfa each summer. In the worst infested sections during 1910, only two crops were harvested and the second of these did not exceed one-half of an ordinary crop.

As a result of the severe injuries during 1910, a bill was framed which passed the 18th General Assembly with scarcely a dissenting vote, providing means for the control of farm pests, including grasshoppers and other injurious insects, rodents, weeds, and plant diseases. The bill is commonly known as the Pest Law and provides for the organization of districts, not to exceed thirty-six square miles in extent, where at least fifty-one per cent of the property is owned by holders who have petitioned for the formation of the district and who have designated someone to act as inspector in the district and who also ...expected to enforce regulations that are furnished by the State

Entomologist for the control of some particular pest or pests. The inspector is paid his per diem and expenses out of the County treasury and is at all times under the control of the State Entomologist and County Horticultural Inspector.

No pest districts have been formed, as yet, probably for two reasons. In the first place, the law did not go into effect until August of the present year and, in the second place, the grasshoppers in northern Colorado have not been at all abundant during the past summer and fall. This seems very strange as the eggs were deposited in unusual numbers during the fall of 1910 and seemed to go through the winter in excellent condition so that the young hoppers appeared in extraordinary numbers during the month of May. From the time of hatching until the time for egg laying, the latter part of August and during September and October, their numbers rapidly grew less, so that comparatively few of the egg pockets were deposited the past fall.

The great diminution in numbers of grasshoppers during the summer is hard to account for. I have noticed in former years a similar condition, namely, that when the grasshoppers become unusually abundant we are almost certain to have a great reduction in numbers in the immediate future. Apparently, this reduction has been due chiefly to outbreaks of the grasshopper fungus, *Empusa grylli*, which, however, has not been very common the past summer, although it is accountable for the destruction of a great number of grasshoppers in northern Colorado during the present year. Farmers have been of the opinion that the red mites (*Trombidium* sp.) have been largely responsible for the destruction of grasshoppers; but from my observations in the field I have never been able to convince myself that these mites were of any considerable importance either in the destruction of the adult grasshoppers or their eggs, and these mites have not been more abundant upon the grasshoppers during the past summer than usual. The blister beetles (*Macrobasis unicolor* and other species have been common but not unusually abundant throughout the infested sections. Dipterous parasites (?) Sarcophagidæ, have been reared in considerable numbers from the dead hoppers but we are not convinced that these flies attack the living grasshoppers. So I shall have to confess my inability to assign any satisfactory explanation for the great reduction in numbers of our grasshoppers in 1911.

The methods of control that we have been recommending and that have been most successful are, first, a thorough harrowing of alfalfa fields, ditch banks and roadsides, where the eggs are mostly deposited, at some time during late fall, winter or early spring. I recommend that the harrowing be repeated several times for the purpose of thoroughly breaking up the egg pockets and bringing the eggs to the sur-

the ground, where they are quickly killed by the action of the probably aided by frequent freezing and thawing. Wherever possible to do so, I recommend deep plowing followed by thorough owing and packing of the soil. In the alfalfa fields, our best ner remedy seems to be the use of the hopper-dozer in one form nother. The most popular dozer in northern Colorado is a long about one foot on each side with the top and back open and covered a screen. Along the front side of the box is a tin or sheet-iron on or shield against which the grasshoppers jump and are carried to a narrow opening at the bottom of the apron, through which enter the box, being attracted by the light at the top and back. In potato fields and about market gardens and orchards arsenic-an mash has been found to be quite efficient. We have not been ry successful in the use of arsenical sprays upon vegetation which being eaten by the grasshoppers.

We have been carrying on a series of experiments during the past ear, for the purpose of determining more accurately and completely he full life histories of our more destructive species, with special ference to the egg-laying habits.

Considerable work is being carried on with various remedies also r the purpose of determining which are most efficient and practical recommend for use upon the farms of this locality. This work has een in charge of Professor S. Arthur Johnson, who will report upon his investigations sometime in the future.

Adjourned.

Thursday, December 28th, 1.30 P. M.

Meeting called to order with President F. L. Washburn in chair.

PRESIDENT F. L. WASHBURN: A paper by Mr. W. D. Hunter, on "The outbreak of *Alabama argillacea* Hbn. in 1911."

W. D. HUNTER. Mr. President and Members of the Association: et me make the statement that this name, *Alabama argillacea*, is nothing more nor less than a name for the cotton caterpillar leaf orm. I shall restrict myself entirely to the manuscript.

THE OUTBREAK OF ALABAMA ARGILLACEA IN 1911

By W. D. HUNTER, *Bureau of Entomology*

ndoubtedly one of the most interesting entomological occurrences 1911 in the United States was the great outbreak of *Alabama argil-*. After nearly a quarter of a century during which this insect acted practically no attention it suddenly appeared in extreme

abundance. In the south the present generation of cotton planters has had but little experience with it and in many localities it was feared as a serious addition to the list of cotton insects. In the north the appearance of large numbers of moths and the injury to fruit aroused similar fears. Among entomologists the outbreak was almost as unexpected as among the laity, as the general impression has been for some years that it was unlikely that the great invasions of former years would ever be repeated.

In many respects the outbreak of 1911 was similar to those which occurred in earlier years and which were described fully in the reports of Comstock and Riley. This similarity extended to the time of the first defoliation, the gradual progression northward, the flight of large numbers of the moths in northern localities in September and October and the comparative immunity from damage of small local areas throughout the territory where defoliation was generally complete. Nevertheless, there are certain interesting features of the outbreak in addition to the fact that it was entirely unexpected. In 1895 Mr. E. A. Schwarz pointed out that great changes which had taken place in the cultivation of cotton in the United States had reacted upon the cotton caterpillar and that the inevitable result would be a lessened probability of future outbreaks. The observations of entomologists who in more recent years have been connected with the investigation of the cotton boll weevil have tended to corroborate Mr. Schwarz' idea. There have been local outbreaks of some severity but no general defoliation comparable to those of the '70s and earlier decades until the great one which took place during the year just past. So great was the change that the cotton caterpillar came to be considered, to a certain degree, a beneficial insect in regions where the boll weevil occurs and the desire was expressed by many planters that it might be possible actually to increase the numbers of the insects present for the effect it would have towards reducing boll weevil injury.

As has been indicated, the outbreak of 1911 was not forecasted in any definite way. There was practically no defoliation in the cotton belt in 1910 nor during at least three preceding seasons. In fact, there was no indication of the outbreak until it had begun. The earliest seasonal records in 1911 were from Brownsville, Texas and two points not far away in Mexico. In the vicinity of Brownsville as early as May 20th the defoliation had begun and by the 10th of June the great majority of the fields had been stripped of their foliage. From Matamoras in Mexico reports of very early defoliation have been received. The same is true of localities in the state of Durango, Mexico. Although these records unfortunately are rather meager

seem to indicate that the insect became extremely abundant early in the season in the northern states of Mexico. Whether infestation was the result of flights from more southern localities the sudden increase of local colonies is beyond determination this time.

In the eastern part of the cotton belt the earliest record of the occurrence of the cotton caterpillar was at Oswego, South Carolina on July fifth. At that time it was exceedingly scarce and in fact did not assume large numbers until the 20th of September.

From the locality near the Mexican border in Texas the infestation radiated rapidly northward and eastward beginning about the middle of June. The flight of the moth did not seem to carry it a great distance in a northward direction. It seemed to obtain an abundance of food after a short flight and was not compelled to make a series of movements.

By the middle of July defoliation began in Louisiana and Mississippi but was not near complete until more than a month later. In North Carolina the earliest occurrence of which we have any record furnished by Mr. Franklin Sherman, Jr., was on August 10th. On September 19th large swarms of the moths appeared at the electric lights in the city of Washington and the invasions seemed to continue until October 29th. These observations were made by Messrs. Schwarz and Pergande who naturally took great interest in it on account of their work on the insect many years before. Mr. Schwarz informs the writer that he does not remember any equally heavy flight of the moths in Washington since about 1882. This northward flight was apparently the result of a development of the fourth or fifth generation of the insect. It is somewhat remarkable that the appearance of the moths in large numbers at lights occurred practically simultaneously at Washington, D. C., Clarksville, Tennessee and Dallas, Texas. This may possibly indicate that there was a heavy inflow of the moths from South America at about this time.

Our conclusions regarding the origin of the outbreak of 1911 is that it started from two infestations. One, apparently unimportant, in the eastern part of the cotton belt, and the other of much greater importance, which began in northern Mexico. The filling in of the intermediate territory in the Mississippi Valley, however, can hardly be explained satisfactorily on the theory that these two invasions increased and eventually coalesced. In fact the general heavy infestation which became noticeable throughout the south early in September can only be explained on the assumption that an invasion of moths from across the Gulf of Mexico took place shortly before that time.

With the sudden increase in the moths there arose an enormous

demand for arsenicals. In former years it became the regular practice of cotton planters to contract for stocks of Paris green or London purple exactly as they did for other plantation supplies. For many years these stocks accumulated and the planters came to believe that it was unnecessary to procure the poison. At the time of the invasion of the boll weevil in Texas many of the large planters had heavy stocks of Paris green with which they carried on experiments against the new pest. In 1904-5 through the agitation of a charlatan, Paris green, as a remedy of the boll weevil, attracted considerable attention. This resulted in exhausting the poison held in the hands of the planters. This was the situation at the time of the outbreak of 1911. Suddenly an unprecedented demand for Paris green and other arsenicals arose. In a few weeks the larger factories throughout the United States were running day and night and in some cases shipping car loads to remote southern points by express. From the city of New Orleans within two weeks time about 800,000 pounds of arsenicals were shipped into the Mississippi Yazoo Delta.

The history of the activity of *Alabama argillacea* is rather complete from 1793 down to 1881. The discovery of the effectiveness of Paris green and the changes in plantation methods, to which reference has already been made, seemed to have caused the cotton worm problem to become of minor importance. At any rate, the available records of the history of the insect since 1881 are of such meagerness as to contrast strongly with full accounts of the earlier years. In order to place on record the history of the pest since the publication of the Fourth Report of the Entomological Commission, the writer has been at some pains to obtain records from numerous sources. Unfortunately the information obtained is exceedingly incomplete. They may be summarized as follows:

1882 to 1890, practically no records found. 1890 seems to have been a year of unusual abundance. This was especially indicated by the appearance of the moth in great numbers in Canada. In 1895 there was also a flight of the moths in regions as far north as Evanston, Illinois, but no special accounts of injury in the south are to be found. In 1900 there was a more or less general defoliation in the coast counties of Texas. In 1904 a late outbreak occurred in Texas and Louisiana but apparently did not extend east of that state; in 1907 in restricted localities in Texas and, to some extent, in Louisiana. To summarize, for thirty years the insect did not occur in sufficient numbers to attract attention except in six seasons. It is not surprising therefore that the planters had generally come to look upon the species as merely of historical interest.

In the rather extensive early literature regarding the cotton worm

...ent references are made to a theory that was propounded in ...6 to the effect that outbreaks are to be anticipated at intervals of 2.. years. This theory was proposed after the great outbreaks of ..., 1804, 1825 and 1846, which, as will be noted, mark regular 21 ... periods. In 1846 it was confidently predicted in the press in the ... that the next outbreak of the moth would occur in 1867. That year displayed no alarming outbreak of the moth, somewhat to the discomforture of the believers in the theory of 21 year cycle. The following year, however, 1868, witnessed one of the most extensive defoliations that has been placed on record. Really, therefore, it may be considered that the outbreak of 1868 is in the regular 21 year sequence. Twenty-two years from 1868 marks the last of the outbreaks prior to 1911 of which we have any record. It is very striking to note that the outbreak of 1911 is exactly 21 years after that of 1890. Among the eight great outbreaks of *Alabama argillacea* which have been recorded, extending from 1783 to 1911, there is only one which does not fit into the 21 year cycle theory. This is the one which occurred in 1872-3. The writer confesses that he is inclined to discredit the theory and is considerably surprised to find that there seems to be but one marked exception. Probably the matter may be explained as a series of coincidences but this is not quite satisfactory on account of the great regularity in the series.

The most interesting feature of the invasion of 1911 from the entomological standpoint is the effect that it had upon the boll weevil. In one way the caterpillar acted very decidedly against the weevil but in another way it favored it. The injurious effect was the result of defoliation of the plants. This allowed the light and heat of the sun to reach the infested squares on the ground and naturally cause the death of many of the weevils in their immature stages. Moreover, the defoliation caused the complete cessation of the growth of the plant so that no fruit was available for the weevils that succeeded in emerging from sheltered conditions on the ground. On the whole the effect of the defoliation was extremely disastrous to the weevil. In fact, this important check coming as it did at the end of a series of three consecutive seasons in which the climatic conditions were very favorable for the weevil was a very important factor in the production of the remarkably large cotton crop of 1911.

The other effect which the cotton caterpillar had upon the weevil was to increase the extent of the dispersion movement in late summer and fall. The defoliation was generally practically complete at the normal time of the height of the dispersion movement. The weevils would arise from a field and fly to another which they would find defoliated and then set out upon a series of

flights that in many cases undoubtedly carried them far beyond the limits they would have reached if normal cotton had been available. Consequently the most extended northward flight of the weevil on record has been found to have occurred in 1911.

As the result of the effect upon the weevil and the fact that the height of the outbreak did not occur until comparatively late in the season, it cannot be claimed that the invasion of 1911 was especially injurious to the crop.

A factor of the situation in which the cotton planters, if not the entomologists, are especially interested is whether there is likely to be another outbreak during the coming season. From *a priori* considerations it seems probable that such repetition is likely to occur. At any rate the chronology of the insect shows a distinct tendency towards series of two or three years in which the damage gradually culminates. On this basis it might be supposed that the invasion of 1911 will be followed by a heavier one next year. Of course, any prediction is extremely hazardous as much depends upon the climatic conditions that may occur between now and spring. The writer has under way studies which may throw light on this subject and for the present will be compelled to withhold a definite prediction as to what may be expected.

President F. L. Washburn: Any discussion of this paper?

Wilmon Newell: Mr. President, I would like to ask Mr. Hunter what, in his opinion, would make the outbreak the coming year less serious than the present one.

W. D. Hunter: Extreme fluctuations in temperature will undoubtedly be the principal factor, and unquestionably a certain degree of humidity. I think, in all probability, the case will be very similar to that of the boll weevil, in which the humidity during the winter months is one of the very important factors in the survival.

Wilmon Newell: You think that high humidity during the winter will be in favor of the insect?

W. D. Hunter: Exactly.

President F. L. Washburn: Does that insect come to maturity on anything other than cotton?

W. D. Hunter: That brings up an old question debated much in the early days. The conclusion arrived at from numerous observations and breeding experiments was that there was absolutely no other food plant. One fact that caused the theory of another food plant to be propounded, was the occurrence of apparently unrubbed specimens in the late fall and early spring. We have two records of unrubbed adults captured at Racine, Wisconsin, one on the 15th of February and one on the 23d of February. I think those cases are

...ined, however, on the peculiar structure of the wing scales, which ...f such a nature as not to be easily rubbed off, as in most moths.

FRANKLIN SHERMAN, JR.: Our first outbreak of it in North Carolina was reported from the 10th to the 15th of August, northeast of Raleigh, and during the two weeks following that time, from the middle to the last of August, we had a dozen reports of it from that section of the State. Two weeks later we got a lot from the cotton growing section of North Carolina, so that during the season we had it practically through all of our cotton growing sections. During eleven years this is the only year in which we have had general destruction by the cotton worm in North Carolina. In the fall of 1905 there was an outbreak in two or three counties in the east central portion of the State.

CORNELIA F. KEPHART: Mr. President, it might be interesting to you to know that up in New Hampshire we had two correspondents send in specimens of this insect, and they claimed they were flocking around in great numbers.

H. A. SURFACE: Mr. President, I was going to say, as a matter of record, that there was quite a flight of these insects northward. I should say, that from the twentieth of September until the second or third of October they were reported throughout Pennsylvania, as one writer said, "countless multitudes, so as to fill the air as by a snow storm," and thousands were sometimes found under a single electric light, and we had them sent to us from almost every county in Pennsylvania.

B. P. MANN: Gentlemen, in looking around, I think I am the only entomologist present connected with the investigation carried on by the United States Department of Agriculture in the early days, and at that time, from 1876 to 1881, we had a little flight of the cotton moth exactly in the same way as we had this year. The air was so full that finally we got to making observations on the food of the cotton moth, and we didn't pay any attention to the moth itself. It was more directed to finding out the food plant of the cotton moth outside of the cotton belt. Well, that went on for years. There were two parties, one led by Dr. C. V. Riley, who advocated the theory that the cotton moth was a native of the United States and had a food plant outside of the cotton belt, and the other party led by Prof. A. R. Grote, who contended that the cotton moth was not a native of the United States and that it had never hibernated in the United States. In the course of time, Professor Grote proved to be exactly correct. The cotton moth never hibernates in the United States and never ...ny other food product to feed upon outside of the cotton plant. ... that makes the Northern flight of the cotton moth much more ...esting than we ever thought.

E. A. SCHWARZ: Many years ago, when the cotton worm in the investigation was carried on with vigor the theory prevailed that the moths hibernated within the cotton belt of the United States, Prof. A. R. Grote, alone, maintaining the opposite view. During the winter of 1879-80 I had been sent on a mission to find hibernating cotton moths or their chrysalids. I went throughout the whole width of the cotton belt, even extending my trip to the Bahama Islands without finding any trace of hibernating moths or chrysalids. Nor has anyone else been able to find any hibernating cotton moths within the United States. In short Professor Grote's opinion has now been generally accepted: viz., that the cotton moth comes to us from some part of tropical America, and probably from some part of Brazil. Of later years I have been in Cuba where cotton is indigenous, but not cultivated to any extent. Here the boll weevil and the cotton stainers (*Dysdercus*) are common enough, but the larva of *Alabama argillacea* is extremely rare and only on one spot could it be collected in moderate numbers: viz., on the hills overlooking the little watering place of Cojimar where a small cotton patch has been planted as an experiment. Subsequently I visited the eastern part of Guatemala where the cultivation of cotton is carried on in a very limited scale without finding the caterpillars; nor did I find any trace of them on the isolated cotton trees at Tampico and Victoria, Tamaulipas. The few perennial cotton trees to be found along the Canal Zone, Panama, were also free from the caterpillar. The Mexican cotton belt at Torreon seems to be protected from the invasion of the cotton moth by its arid climate, and that, the same region is free from the cotton boll weevil, is, in my opinion, only due to its isolation, the nearest weevil infested region being several hundred miles distant.

The migration of the cotton moth north of the cotton belt in the United States has years ago been a familiar sight and numerous references thereto can be found in our literature of about 30 to 35 years ago. At that time the theory prevailed that the cotton moth had some other food plant within the northern states. This theory has long since been abandoned and the northward flight of the cotton moth whenever it occurs, is a most remarkable and unique phenomenon in the domain of entomology. In former years very little attention was paid to the duration of such flights but in the present year the duration of the flight has been watched at Washington, D. C. It extended from September 19th to October 19th as will be more fully found to be published in the forthcoming number of Proc. Ent. Soc. Wash.

PRESIDENT F. L. WASHBURN: Anything else on this paper?

H. T. FERNALD: I simply wish to report that in Massachu

...ured this species in considerable numbers on the 28th of September.

A. SURFACE: Just one important observation should be recorded. I found them very injurious to Salway Peaches. I found that after the fruit ripened they would insert their probosces, sucking out the juice in a circle half an inch in diameter and they would also stain the fruit brown, a very serious damage, amounting to many dollars.

E. N. CORY: I would like to make a report from the Maryland Station of the occurrence in large numbers of this moth at Adamstown, in Frederick county, and cite a report by a correspondent that the moth was injuring crops, puncturing grapes and feeding on the juices to a considerable extent. We were unable to verify the report.

PRESIDENT F. L. WASHBURN: We will have to stop this discussion here, I am afraid. The next paper will be read by Mr. Jennings, on "Some Problems of Mosquito Control in the Tropics."

SOME PROBLEMS OF MOSQUITO CONTROL IN THE TROPICS

By ALLAN H. JENNINGS

That part of Panama which comprises the Isthmian Canal Zone lies in about 9° of north latitude and is characterized by a typically tropical climate, high humidity, heavy rainfall, and a short dry season, usually lasting not more than four months, sometimes decidedly less. A rich virgin soil is clothed by dense and luxuriant vegetation. Of a hilly, in some parts mountainous topography, it is well watered by numerous brooks, streams and rivers. The climate is equable, the temperature never rising to excessive heights, and the seasonal variation is slight. High winds and violent storms are practically absent and thunder storms, even without wind, are rare compared with their occurrence in the temperate United States. In the rainy season, when well established, precipitation is not constant; the daily rain usually occurs about noon and continues for a longer or shorter period, the nights and mornings being usually clear. The yearly rainfall is not equal in all parts of the Canal Zone; the extremes are noted at Colon and Panama, precipitation being about twice as heavy at the former place as at the latter. While least rain falls at Panama and in the country close to the Pacific coast-line, heavier precipitation begins several miles before the divide is reached at Culebra, and from the latter point to Colon, about thirty-three miles away, the rains are very heavy.

As is to be expected in a country exhibiting such conditions, the

mosquito fauna is rich and includes about 125 species representing all the genera typical of tropical America. The seasonal incidence of many species is but slightly marked, breeding continues throughout the year and is only relatively reduced in the height of the dry season. In fact in some localities and with certain species, it actually increases at that time, for water courses and rivers which during the rains, by reason of rapid current and proneness to floods, offer no opportunities for mosquito propagation, become during the dry season a succession of pools or long reaches of stagnant water in which Anopheles and Culex species fairly riot in their abundance and, unless checked, are a serious menace to the population of the vicinity. Æstivation, at least as regards most species and especially those of economic importance, seems not to occur as oviposition takes place whenever opportunity in the shape of water is to be found. Economically important species are abundant, including at least nine species of Anopheles, the nearly cosmopolitan *Stegomyia calopus* and *Culex quinque-fasciatus*, and other species which are abundant and annoying pests. Only a few of these are of known pathogenic habits, but all except the most retiring of the sylvan species have to be reckoned with by the sanitarian and included in the programme of control.

The range of habits in the species is wide and extremes in specialization of form and habit are seen, especially among the sylvan species. Many are restricted to a certain type of breeding place, the water-bearing flowers of a certain genus of plants, or even to those of a single species. Others among the sabethines and culicines are less exacting and are to be found beyond the strict confines of the bush, will breed in artificial containers, and are occasionally to be found in the adult state about houses, if the latter are in reasonable proximity to their breeding places.

In connection with specialization or restriction of habit should be mentioned *Stegomyia calopus*. This mosquito is intensely domestic, is never found, except by accident, away from the immediate neighborhood of man's habitations, and will breed only in such artificial vessels or situations as it there finds. This rule is absolute and I know of no exceptions thereto having occurred. I have known this mosquito to breed in water-filled hollows in trees standing beside inhabited dwellings, these filling the same rôle as the artificial container, but never in ground water of any description. These habits entail a line of control work, totally different from that employed against Anopheles, the details of both classes of work I will discuss later.

Anopheles albimanus, among pathogenic species, is by far the most important, under present conditions, not excepting *Stegomyia calopus*. Not only is it the most abundant of the Isthmian species of the

s but its persistence in biting and in gaining entrance to habitations are greater than is the case with any other species. In addition to this, it has been shown that upon ingestion of the parasites of malaria a larger percentage of the females became infective and able to transmit the disease than occurs with any other species of the region. The breeding places of this species show great diversity of character, though preference is shown by the mosquito for stagnant, fairly pure water, exposed to direct sunlight, with a growth of Spirogyra, which alga is a favorite food. Sewage contamination is inimical to the species when such contamination is marked. Rapidly flowing water also is unsuitable and streams with a strong current are usually quite free, except in back waters and hollows where the current is little felt. I have never taken *albimanus* in artificial containers except in one or two instances when the occurrence was evidently purely accidental. With the exception of foul or swift water they may occur in almost any collection of water, however small or seemingly unsuited to mosquito propagation. Hoof-prints, wheel-ruts, the smallest puddle or thinnest film of water seeping upon the ground from a wet hillside, particularly if the ubiquitous algæ are present, are points of danger and must be included in the control work. For an *Anopheles* the flight of *albimanus* is strong and observations, which unfortunately fall short of demonstration, indicate that, under a proper combination of circumstances, it will cover a distance of at least one mile from its breeding place. While not domestic in the same sense as *Stegomyia calopus*, *Anopheles albimanus* is closely associated with man and finds its most congenial surroundings about his habitations and in the conditions he creates in the course of agricultural, engineering and other work. This fact is correlated with the highly developed blood-sucking habit and has been an active factor in its development and in establishing the economic importance of the species.

Anopheles tarsimaculata is much less abundant and widely diffused on the Isthmus than *albimanus* and, though it is exceedingly numerous in certain localities, it is largely confined to the Atlantic seaboard. I have observed but few individuals of the species more than six miles inland, that is, away from conditions obtaining upon the low coastal plain. Where it occurs abundantly it is as great a pest as *albimanus*, which occurs coincidentally with it in the neighborhood of Colon and Gatun. It also is a transmitter of the malarial parasite and the habits of the two species are similar.

Anopheles argyritarsis is less abundant than either of the foregoing. It is known to transmit malaria, at least occasionally. It is widely distributed over the Isthmus but its numbers are never very great in any locality and it is not very frequently found in buildings. By

reason of these facts, it is far less important economically than *Anopheles albimanus* and *tarsimaculata*. It is the only species of Isthmian Anopheles which breeds readily in artificial containers. In ground water it prefers the smaller collections, such as water seeping from springy hillsides and filling the smaller depressions in soft ground, also ditches carrying but a trickle of water and similar situations. It seems quite dependent upon the presence of algæ.

As an annoying pest and as a malaria carrier *Anopheles pseudopunctipennis* falls below *Anopheles albimanus*. It occurs abundantly from ocean to ocean but is somewhat more discriminating than the latter in choice of breeding places. It prefers as a rule water of greater purity and rapidity of current. The larval food, like that of *albimanus*, is by preference the soft green algae, though it does not scorn, lacking better, many places departing quite widely from the chosen type. At times its abundance is enormous, though usually far fewer of this species will find their way into buildings than is the case with *albimanus*, and its flight is less vigorous. Biting experiments with *albimanus* and *pseudopunctipennis* have shown that under identical conditions less than one *pseudopunctipennis* becomes capable of transmitting malaria to five *albimanus*.

Anopheles malefactor is widely distributed and abundant locally. It is a large handsome species, a vigorous biter, active in entering houses, but apparently does not transmit malaria, as Darling failed to infect individuals which were fed at the same time and upon the same patient as specimens of *albimanus* which became infected.

In addition to the foregoing occur *Anopheles punctimacula*, which I have never taken and is certainly rare, and *Anopheles apicimacula*, which is fairly abundant locally and occasionally. It does not often find its way into screened buildings and its breeding habits are not peculiar though a preference is shown for semi-sylvan situations with more or less shade. Temporary grassy pools formed by heavy rains or overflowing streams, waterfilled depressions in low bush, completely shaded and devoid of visible living vegetation seem to be the characteristic breeding places.

Anopheles eiseni is a strictly sylvan species and breeds in depressions in the rocky beds of mountain streams, where protection from the rapidly flowing current is afforded; also in tree holes and bamboo stumps. It is fairly abundant in favorable localities, yet I have never observed adults of the species at large by day, even in the dim light of the dense forest, nor at night when camping in the vicinity of active breeding places. I have no record of its entrance into buildings and have never taken the larvæ even a few yards beyond the edge of the forest. The relation of *eiseni* to malaria is not known as it has been

...sible to collect and breed sufficient material with which to work. A species closely related to *Anopheles cruzi* is remarkable for its habit of breeding only in water held in the leaf axils of various species of epiphytic bromeliads. In certain highly favorable localities the larvae of this species are fairly common, though never abundant in the sense in which the term is used in connection with the commoner species. An exceedingly humid climate with heavy rainfall, fostering a luxuriant growth of bromeliads, is the only condition under which I have taken the species, which is yet to be recorded from within the strict boundaries of the Canal Zone. My material was all collected at Porto Bello on the coast, twenty miles east of Colon, and some seventy miles in the interior, near the headwaters of the Pequini River, both localities being within the area of heaviest rainfall of the region. Like the last, this species was not observed free in the adult state, even when in camp near its breeding places. Nothing is known of its relation to malaria transmission. Its rarity and the infrequency of conditions suitable to its propagation along the line of the canal render it economically negligible.

In the foregoing notes, the data relating to the transmission of malaria by Isthmian Anopheles are quoted from the published work of Dr. S. T. Darling, Chief of Laboratory, Ancon Hospital.

The division of the Department of Sanitation charged with the work of mosquito control is composed of a chief sanitary inspector and his assistant, three division inspectors, and about twenty-five inspectors apportioned among the seventeen line stations or districts. Each district inspector is held responsible for the physical condition of his station as it affects the breeding of mosquitoes and indirectly for the "malarial rate" or cases of malaria occurring each week as expressed in terms of percentage of population. In addition, he is charged with the enforcement of the sanitary regulations in his station, a matter of no small importance and even of difficulty in the case of the native towns. In the latter duties he is supported by the police of the Canal Zone, when such support is necessary. Co-operation with the local district physician in all health matters is enjoined and daily reports of malaria cases recorded at the dispensaries are sought for and obtained. Frequent inspections of the entire station are made by the inspector or his assistants, these inspections including the most minute detail of all physical features to the end that breeding may be anticipated, or, if already established, be noted and remedied at the earliest moment.

The regular program of oiling is laid out by him and executed by the foremen of oilers under his general supervision and inspection, as is the work performed by other departments for the Department of Sanita-

tion. Inspection of native and American towns for Stegomyia and Culex breeding containers is made, either by himself or assistants or by negro foremen closely checked by the inspector. The results of these inspections, the number of containers with larvæ found and of houses inspected are reported weekly to headquarters, as are the results of the mosquito catch in barracks. In this report are given the number of each house inspected, the times inspected, and number of each class of mosquitoes captured, also the total number of mosquitoes taken in the station. These and the reports of the division inspectors, who visit the stations at frequent intervals, the number of malaria cases which have occurred during the week, together with all the factors involved in the situation, are carefully considered. The result of this study is taken to indicate the condition of the station and upon it is based the program for future work.

Previous to the advent of the Americans in 1904 the Isthmus of Panama had not enjoyed the benefits of any efforts at control of the universal pest of mosquitoes and the accompanying scourges of malaria and yellow fever. Indeed, so new were the discoveries which established the connection between these diseases and their insect transmitters, that the days of active prosecution of canal work by the French had passed before the results of the discoveries became practically available to the world, for the control of such conditions as then prevailed in Panama. With the entrance of the U. S. Government upon the field, the work of controlling and eradicating the twin pests which had so long dominated this part of tropical America was taken vigorously in hand.

At first directed entirely against yellow fever, then frequently occurring in the ports of Colon and Panama, it was, when that disease had been stamped out, extended to the control of malaria and eradication of Anopheles mosquitoes in the inhabited portions of the Canal Zone. The result is that today yellow fever may be regarded as a remote possibility and malarial incidence has long been reduced to such a point that the health of the Canal Zone bears favorable comparison with that of most portions of the continental United States. I should add that in the maintenance of such desirable conditions, as far as yellow fever is concerned, an efficient quarantine has effectively co-operated with the Department of Sanitation by successfully excluding all cases of the disease.

The character of the population of a country in which the control of mosquitoes and the reduction of malarial disease is attempted, plays an important part in the success or failure of the undertaking. An intelligent and tractable population will greatly aid in the thoroughness with which mosquito control work may be accomplished, while opposite

characteristics will throw many obstacles in the way of physician and sanitary inspector. It is interesting to note that the employee population of the Canal Zone is highly cosmopolitan and includes representatives of more than twenty nationalites. A large part of the manual work is performed by West Indian negroes, while a large minority of the laborers are Spaniards from old Spain, some Italians and a few Greeks. Few native Panamanians are employed, as they do not take kindly to severe manual labor and usually prove rather inefficient.

Of the laborers living in Commission quarters, the West Indians as a whole give probably the least trouble in the enforcement of sanitary regulations, owing in part to their submissiveness to recognized authority and their habits, having been taught by experience the danger of exposure to the "night air" or rather the inhabitants thereof. The Europeans from non-malarious countries, however, are restive under restraint and freely expose themselves, during nightly wanderings and otherwise, to malarial infection. Both classes have during late years shown a strong propensity to "go to the bush" and, squatting upon a patch of land, usually beyond the area of control work, build a shack, of course unscreened, and live, working intermittently for the Commission, exposed to all the unwholesome influences the country has to offer.

In the work directed against Stegomyia and house mosquitoes the inhabitants of the so-called "native towns," populated largely by ex-employees and intermittent workers, are through ignorant carelessness the cause of much trouble to the sanitary force and their premises require constant inspection. It is difficult to convince the average "Jamaica lady" or her spouse that the presence of a tin full of water and "wrigglers" upon their back porch is anything more than a venial sin. Innumerable and ingenious excuses are offered but often arrest and fine are the only means to effect reform.

No less important than the anti-malarial work but of a radically different character, Stegomyia eradication is merely a matter of painstaking, conscientious and thorough inspection of premises and their contents, the destruction of useless containers, efficient screening of water barrels and cisterns, and oiling of such receptacles as cannot be otherwise protected. If yellow fever be present, the fumigation of houses for mosquito destruction is also necessary. The measures directed against Stegomyia of course control the other, and next important house mosquito, *Culex quinquefasciatus*, and in practical work no distinction is made between them. The presence of "mosquito larvæ" of any species is sufficient cause for reprimand or fine as the case may be.

At the beginning of the work, with so gigantic a task to perform in the shortest possible time, the most energetic efforts were necessary and measures were adopted that would produce the most immediate, although temporary, results. When the situation, however, was somewhat in hand, the practice was modified and work of a more thorough and permanent character undertaken. The principle underlying mosquito control as now practiced in the Canal Zone is the gradual creation of permanent conditions inimical to mosquito propagation, while the situation is kept in hand by more or less superficial and temporary work. Prophylaxis is practiced in the careful screening of quarters and the administration of quinine, as universally as possible, to those exposed to infection.

The attainment of the ideal condition of a permanently mosquito-free territory through artificial means is manifestly impossible in such a climate as that of Panama. The battle with nature is unending and the slightest relaxation means a rapid reversion. Yet work of a permanent nature is, in the end, far more economical and leaves the sanitary forces free to carry on the fight upon the outlying portion of the controlled area, gradually forcing back the danger line and extending the zone of permanent improvement. By permanent work is meant primarily the thorough and rapid drainage of the land, either by the use of tile or by open concreted ditches, the drainage of permanent swamps and the filling in of low ground. Open ditches through earth or clay are exposed to rapid deterioration and require constant care, with attendant expense and lower efficiency.

Among the important phases of permanent or semipermanent work is the clearing away of the bush or jungle which would give shelter to mosquitoes in the vicinity of habitations. The area cleared varies with the conditions, but usually a belt approximately 1000 feet wide about inhabited buildings is desired. The cutting of grass in the same situations should be included with the work just mentioned, though this must be performed sometimes as often as once each month.

As a supplement to permanent or temporary drainage, the means on which most reliance is placed is the use of larvacides, either in the shape of crude oil or a combination of caustic soda, crude carbolic acid and resin, which is manufactured by the Department of Sanitation. Each of these materials has its faults and advantages. The oil is bulky and drifts with the wind to one end or another of the body of water, leaving a large part of the surface exposed to oviposition. When "cut" with about ten per cent. of the "larvacide," by which broad term the manufactured product is designated, it is largely used on small collections of water, such as hoof-prints, where the surface can be entirely covered and, unless floated out by inundation of the

...s, the effect is very lasting. Its bulk is a serious obstacle to its ...ed tanks, filled from the tank cars in which it is received, are ...d at various points in each station which can be reached by rail. ...d carts are used to transport the oil where roads exist; but in ... and broken country, pack-mules must be resorted to in distributing the supply to the oilers and in filling drip barrels. The oil is applied by means of a knapsack spray-pump and by drip barrels provided with a specially devised spout from which the oil drips slowly. These are placed at the head of ditches and small streams at a good height above the water, upon striking which, the drop spreads immediately to a thin film and floats away. This automatic method is very effective.

The manufactured larvacide possesses the advantage of very much less bulk, though this is partly offset by the fact that the entire body of the water is permeated and a correspondingly larger amount of the preparation must be used. It also is applied by spray pumps at a strength of about 20 per cent. in water. It is quickly fatal to the larvae of mosquitoes but unfortunately also to fishes and the predaceous larvae of dragon and damsel flies and other aquatic insects. Its effect is quite evanescent and it must be renewed at short intervals, but the thoroughness and quickness with which it does its work renders it exceedingly effective. It is not suited to use in bodies of water of large volume, though when applied to the edges of even large streams the results are excellent. Though sometimes unavoidably interrupted, the plan of oiling operation provides for the covering of all territory every seven days, and this period is sometimes shortened in case of necessity. This effectively anticipates any possible emergence of adult mosquitoes, should breeding have recommenced.

The catching by hand of mosquitoes in barracks to which they have gained access is an important aid in preventing malarial infection. Colored laborers, chosen from the oiling gangs for intelligence and reliability, are selected for the purpose. These men are armed with killing bottles charged with chloroform with which they go through the buildings, catching the resting mosquitoes, of which they secure a large percentage. The visits are made daily or at longer intervals as the degree of infestation demands. After once entering a well screened building, few Anopheles escape and if the blood-filled female is overlooked by the catcher upon his first round, she is almost certainly captured before she has reached the infective period. An adjunct to the killing bottle, in the shape of a wire gauze fly killer or "swatter," in the language of the day, is also carried by the men and is useful in ...ing such mosquitoes as are inaccessible to the killing bottle. Small electric torches have been used by inspectors in examining

buildings for the presence of mosquitoes and are very useful, especially upon overcast days and in poorly lighted native houses. The fumigation of buildings for the destruction of Anopheles mosquitoes is not now often practiced and is resorted to only in rare cases of excessive infestation and malarial infection.

The natural checks to mosquito propagation, which are quite effective in northern countries, fail as an important aid to control work where plant life is so exuberant and the multiplication of mosquitoes so prolific and persistent as is the case in Panama. Small fishes of many species, including several of Gambusia, are very abundant and occur in the smallest brooks and open ditches. Though they destroy many larvæ, they cannot effect the eradication which is essential to the work and must be disregarded, together with predaceous aquatic insects.

Special and exceptional problems are being constantly presented due in many instances to the engineering work connected with canal construction. Swamps of large area are sometimes unavoidably created and before drainage can be effected, breeding of Anopheles has assumed formidable proportions. The gravity of the situation is also, often increased by the difficulty of applying control measures. In some instances boats of shallow draft have been employed to carry powerful force pumps capable of throwing oil many feet, the crew being armed with axes and machetes to cut away tangled undergrowth. Hydraulic fills, formed of the material from suction dredges spread over low-lying areas, are among the most serious and difficult situations to control. Breeding is active, especially as the water drains away and evaporates, while the soft mud, often with a deceptive crust upon it, offers an almost insuperable and often dangerous obstacle to penetration of the area. Slides of earth and mud, developed in the course of excavation, often cover areas many acres in extent and are always prolific breeding places. Like the hydraulic fills, they are difficult, and even more dangerous, to venture upon.

The great Gatun lake, with its approximately two hundred square miles of area and hundreds of miles of rugged shoreline, bids fair to offer many problems as its level continues to rise. In the sheltered bays and indentations of its shore line, aquatic vegetation riots, and as the waters inundate the tropical forest, a condition is created, ideal for the most prolific breeding of Anopheles and other mosquitoes: a tangle of living and dead vegetation, with floating debris from the dying trees, among which water plants flourish. A large part of the breeding areas formed will probably affect only scattered habitations and ranches but, wherever settlements and towns are contiguous to the permanent shore line, correction of these conditions will be

...ive. It is obviously impracticable to thoroughly clear and ... square miles of territory, covered with heavy timber and soon ...aried beneath the waters of the lake, but until the permanent ... reached the uncleared and shallow margins of the lake will ... myriads of mosquitoes to the adjacent regions.

In conclusion I would emphasize the fact that the sanitary organization of the Isthmian Canal Zone has prosecuted the work of mosquito control in the face of great difficulties of climate and situation. Constant changes in physical conditions have necessitated prompt and energetic action in the contrivance and application of relief measures. Heavy demands have been made upon the resourcefulness, ingenuity, devotion and physical endurance of the personnel, and upon their response to the call has largely depended the high success attained.

PRESIDENT F. L. WASHBURN: Any discussion on this paper, of the utmost interest to us all? Doctor Schwarz.

E. A. SCHWARZ: As with everyone that has visited the Canal Zone, I cannot but admire the efficacy of the work done by the sanitary department of the Canal Zone Commission in cleaning up the mosquitoes from the country so that yellow fever is practically unknown and malaria under almost perfect control. The common non-pathogenic mosquitoes are not obvious at all during the dry season of the year but as soon as the summer rains commence, they are just as common all over the Canal Zone as elsewhere. On a short trip up the rapid flowing Chagres River, I was not aware of the presence of any mosquitoes and at Porto Bello up to which place the operation o fthe sanitary department has not yet extended and where there are many clear mountain streams, I was never seriously troubled by the attacks of mosquitoes.

PRESIDENT F. L. WASHBURN: Any other remarks upon this paper?

HENRY SKINNER: Mr. President, the speaker said something about *Anopheles* breeding in depressions. I just wanted to find out whether, in a tropical country, the water would remain in such long enough to enable the mosquitoes to undergo their transformations. It might be a matter of some little importance to find that out.

ALLEN H. JENNINGS: A depression will be filled many times before ... emptied, and where the soil is fairly impervious, as it is in many ... the water will remain an ample time; in fact, far more than ... enough for the transformations to take place.

...DERICK KNAB: One little point I would like to call attention ... that is the fact that the habits of the different species of *Ano-* ... have everything to do with their relation in carrying malaria. *Anopheles albimanus*, which is the principal malaria carrier if ... understood Mr. Jennings correctly, is to a certain extent domes-

ticated in so far as it occurs mostly about habitations. In conversation he has informed me that he didn't find that species in the upper Chagres River, where there were no habitations. It seems on the other hand that the species which occur in the wild play no part in the transmission of malaria,—rather a curious fact. (See p. 196 for a more extended discussion of this phase.—ED.)

PRESIDENT F. L. WASHBURN: The next paper on the programme is by Mr. Yothers, of Orlando, Florida.

INSECTICIDES FOR USE IN CONTROLLING THE WHITE FLY

By W. W. YOTHERS, *Orlando, Fla.*

(*Withdrawn for publication elsewhere*)

MR. BERGER: Mr. President, we believe in Florida that these formulas, that Mr. Yothers has invented, are a decided advance in the matter of the application of oils. They have, of course, so far been applied to citrus trees which are evergreen, and the suggestion that is foremost in my mind here, is the possible usefulness of these insecticides or spraying solutions in the North on trees in full foliage. I might add that a prominent nurseryman in Florida, who grows ornamentals, is using formula 4 and experimenting with it in the greenhouse, with apparent success. The use of these mixtures on other plants besides citrus is of course, in the experimental stage, but the outlook is promising.

PRESIDENT F. L. WASHBURN: Any other member who wishes to discuss this paper? If not we will pass to the next paper, by Mr. R. A. Cooley, of Montana, on "Orthoarsenite of Zinc as an Insecticide."

ORTHO ARSENITE OF ZINC AS AN INSECTICIDE

By R. A. COOLEY, *Montana Agricultural Experiment Station*

During the past two seasons the Montana Experiment Station has had opportunity to experiment with the insectitude furnished by the California Spray-Chemical Company, called ortho arsenite of zinc. Two lots of the chemical have been used, one received in May 1910 and one in May 1911. Our observations have been concerned with its suspension qualities, injuriousness to the bark of the apple tree, and killing power with insects.

This ortho arsenite of zinc is a very finely divided, white, fluffy powder, a given weight occupying about four and one-half times the space of Paris green. If first rubbed into a paste with a small amount of water, it mixes well in proper dilutions for spraying.

...ther understanding of the physical qualities of this insecticide ... obtained by referring to the accompanying photographs of ... ates, which had been sprayed with arsenate of lead (pl. 2, fig. ...nite of zinc (pl. 2, fig. 2) and Paris green (pl. 2, fig. 3). All are ...ed 8 diameters. It will be observed that arsenate of lead and ...te of zinc spread equally well, adhering to the glass as many ...ingly fine particles, while the coarser granules of Paris green ... settled to the edges of the droplets and could be easily removed ...

The manufacturers claim that the product contains "over 40 per cent of arsenious oxide," which would be about four-fifths as strong ... this form of arsenic as is Paris green. Compared with arsenate of lead, it contains 40 per cent of arsenious oxide against twelve and one-half per cent of arsenic oxide (As_2O_5) required in the arsenate.

An analysis by Professor Burke of the Montana Experiment Station showed the sample to contain 0.67 of one per cent of water-soluble arsenic against 3.5 per cent allowed in Paris green and 0.75 per cent of arsenic oxid (As_2O_5) allowed in arsenate of lead. Thus, this insecticide is intermediate in strength between our two standard arsenicals, and with respect to the water-soluble forms present is better than either. We have not made analysis to determine the total arsenic present.

Suspension Qualities

Experiments conducted by Mr. J. R. Parker and reported in bulletin No. 86 of the Montana Experiment Station (1911), have shown that the addition of soap to water mixtures of arsenate of lead and arsenite of zinc has a marked influence on the rapidity of settling of these compounds. You are referred to the original record for the details of the experiments, but we wish here to compare the results obtained. Previous tests had shown that the suspension of Paris green is unaffected by the addition of soap to the water.

The method followed was to thoroughly mix known quantities of the poison in 600 cc. of water in glass cylinders. Two grams of soap in solution were added to one cylinder, while the check was left without soap. After being left for definite periods, 500 cc. were siphoned off from the top, the 100 cc. in the bottom removed to an evaporating dish, dried, and weighed. Before any settling began the bottom 100 cc. naturally contained one-sixth of all the poison placed in the total 600 cc. of water. Thus the difference between this one-sixth and the amount found in the bottom 100 cc. after settling had taken place ...d how much had settled out of the 500 cc. at the top. Ten ..., dry, of arsenite of zinc and 20 grams of arsenate of lead in ... form were used in each test.

The following tables deduced from the bulletin above referred to show the results of certain of the tests in a graphic way.

TABLE NO. 1

WEIGHT[1] AND PERCENTAGE OF SEDIMENT IN LAST 100 CC.

Time	Arsenate of lead without soap		Arsenate of lead with soap		Arsenite of zinc without soap		Arsenite of zinc with soap	
	Grams	Per cent	Grams	Per cent	Grams	Per cent	Grams	Per cent
15 Minutes	7.4	63.2	4.7	39.3	7.6	76.0	2.6	[illegible]
30 Minutes	9.6	82.0	5.1	43.5	9.2	92.0	3.2	[illegible]
45 Minutes	11.3	96.0	5.4	46.1	9.3	93.0	3.3	[illegible]
60 Minutes	11.4	97.4	5.2	44.4	9.5	95.0	3.3	[illegible]

TABLE NO. 2

WEIGHT[1] AND PERCENTAGE SETTLED OUT OF 500 CC. ABOVE THE LAST 100 CC.

Time	Arsenate of lead without soap		Arsenate of lead with soap		Arsenite of zinc without soap		Arsenite of zinc with soap	
	Grams	Per cent	Grams	Per cent	Grams	Per cent	Grams	Per cent
15 Minutes	5.5	56.1	2.8	28.5	6.0	71.4	1.0	[illegible]
30 Minutes	7.7	78.5	3.2	32.6	7.6	90.4	1.6	[illegible]
45 Minutes	9.4	95.9	3.5	35.7	7.7	91.6	1.7	[illegible]
60 Minutes	9.5	96.9	3.3	33.6	7.9	94.0	1.7	[illegible]

It is thus apparent that without soap added to the mixture arsenite of zinc settles slightly quicker than arsenate of lead, but that with the addition of soap the settling of both is retarded. This is particularly striking with arsenite of zinc. In another test, not here reported, more of this compound settled out in fifteen minutes without soap than in fifteen hours with soap.

Injury to the Bark of Apple

Professor D. B. Swingle of the Biology Department of the Montana Agricultural College is engaged in an extended study of the effects of arsenical compounds upon vegetation, and in this connection has made a series of tests on apple trees. During the season of 1910 the following compounds were used; arsenic acid, arsenic trioxide, arsenite

[1] Dry weight of arsenate of lead used, 11.7 grams (20 grams paste). Dry weight arsenite of zinc used, 10.9

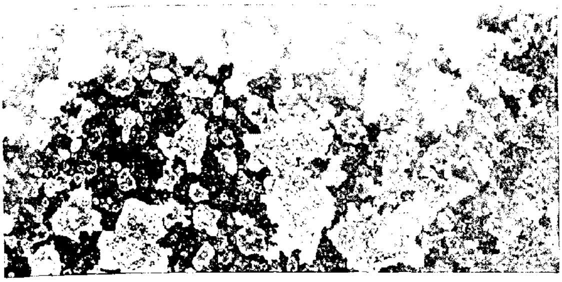


Fig. 1. Arsenate of lead.

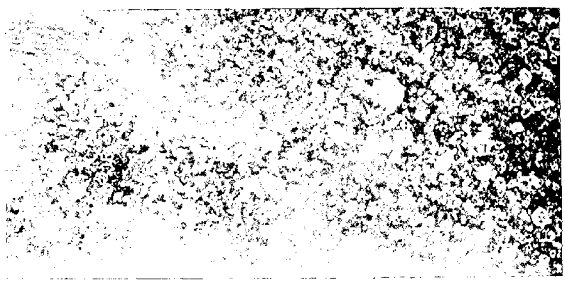


Fig. 2. Arsenite of zinc.

Fig. 3. Paris green.

Photographs of arsenical insecticides sprayed on glass to show the distribution of each. The larger size of droplets in Fig. 1 is not of special significance. All magnified 8 diameters.

...phid. arsenic trisulphide, calcium arsenite, lead arsenate (a mixture of ortho and acid arsenates) Paris green (from Ansbacher & Co.,) ...um arsenite and zinc ortho arsenite from the California Spray Chemical Company. These were applied to branches varying from one-fourth to two and one-half inches in diameter and to crowns of ... three to five inches in diameter. Weighed amounts were spread on small squares of absorbent cotton, which were wrapped about the limbs in such a way that the chemicals were applied to the bark in a fairly even layer, completely encircling the limb for a distance of about four inches. These were then kept wet with distilled water during the term of the test. These bandages on the limbs were intended to roughly simulate the physical conditions, especially as to moisture, found naturally about the crown of the trees where the chemicals are known to accumulate from spraying with arsenical insecticides. In treating crowns, the earth was removed to form a shallow trench close about the tree, the chemicals, suspended in water, were poured in and the earth replaced. A part of the limbs and crowns used were wounded in various ways and to various extents.

The experiments and the results here discussed were published during the past year and you are referred to the original paper for further details. See, "A preliminary report on the effects of arsenical compounds upon apple trees." D. B. Swingle and H. E. Morris, *Phytopathology* Vol. 1 No. 3, June 1911, pp. 79-93.

Of the various chemicals used, ortho arsenite of zinc is the only one which, up to the present time, has caused no visible injury under the various conditions of the tests. In a number of instances wounds which had been made under the bandages and in the crowns for the purpose of allowing access into the circulation of the trees, thereby making the tests more severe, healed completely while continually covered by and in contact with the poison.

In strict truthfulness, it should be stated that in a single instance there was a superficial discoloration of the bark about three mm. in diameter under a lenticel. We believe this to be of no practical significance, however, when we consider that in all cases where the bark was opened by the removal of a twig, a tangential slash to the cambium, or by peeling to the wood, no injury whatever was inflicted.

Killing Power

Comparative tests have been made on potatoes for the Colorado potato beetle and on cabbages for larvæ of the European cabbage butterfly and of the diamond back moth, (*Plutella maculipennis* Curt.)

On potatoes, ortho arsenite of zinc was used at the rate of one pound to 50 gallons of water applied by a field sprayer on the Experiment

Station farm. To another portion of the field, Paris green was ap... at the rate of one pound to 50 gallons of water. Arsenite of zi... one pound to 50 gallons was as effective as Paris green and both... entirely satisfactory. At one pound to 75 gallons of water, ars... of zinc was not entirely effective.

On cabbages the same insecticides were used and arsenate of ... also. In these experiments, which were made for the purpo... testing the practical advantage of the addition of soap to caus... insecticide to adhere, arsenite of zinc was used only in the streng... three pounds to 100 gallons of water, while arsenate of lead was ... at the rate of six pounds to 100 gallons and Paris green at one po... to 100 gallons. Both of the cabbage pests mentioned were compl... controlled and arsenite of zinc did no injury by burning, while Par... green distinctly injured the plants sprayed from the bottom of th... knapsack sprayer used. Arsenite of zinc, then was as satisfacto... as arsenate of lead and more so than Paris green.

Cost

The manufacturers intend this insecticide to be sold at 20 cents pe... pound retail. Pound for pound it is thus cheaper than Paris gree... and considering its relatively high arsenic content, is much cheaper than arsenate of lead.

Summary

From the foregoing summary statement it seems to be appare... that neutral arsenite of zinc should have an important place among our arsenical insecticides.

1. It is finely divided and spreads well.
2. It is nearly as strong in arsenic as is Paris green.
3. It has a very low water solubility.
4. Its suspension qualities are markedly benefited by the additio... of a small amount of soap to the water.
5. Under our tests it has been shown to be less injurious to the bark of the apple tree than any other arsenical compound used.
6. In killing power it compares well with the standard arsenica... insecticides.
7. Its cost make... economical poison to use.

President F. L. Washburn: We would be very glad to hear a discussion of this paper.

President F. L. Washburn: The next paper is by Mr. Ba... of Utah, on "The Efficiency of the Driving Spray for the Codling Mo...h."

THE EFFICIENCY OF THE DRIVING SPRAY

By E. D. Ball, *Utah Experiment Station, Logan, Utah*

... years ago the writer presented to this society a paper setting ... the methods used and a summary of the results obtained with ... driving spray. This paper was neither comparative nor controversial. It set forth one method only and gave the results obtained through a series of years. Its aim was to acquaint the entomological workers with a method found to be highly efficient in the West and to leave it to their own good judgment as to the possibilities of adapting it to their own conditions.

Since that time, a great deal of work has been done on the subject, both East and West, and a number of papers have been published. It was, however, very unfortunate for the popularity of the driving spray that the second contribution to the subject should have been uncritical in manner, over enthusiastic in its claims, and founded upon results obtained under exceptionally favorable conditions.

Little wonder, then, that the further literature of the subject contained articles both controversial and severely critical of the driving spray. The writer's sympathy was, however, with the later writers, even when they included his own work in the criticisms. Besides antagonizing other workers, the "one spray and one pound of poison" slogan misled many fruit growers in the West with a resultant severe financial loss. Just how much of this loss was due to the original publication and how much to the arsenical poisoning propaganda, the meteoric career of which nearly coincided with and for the time being enhanced the popularity of this fallacious dogma, no one can tell. Certain it is that the combination resulted in financial disaster to the fruit growers in many of the western localities in which it was accepted. Let us hope that the good done in stimulating other and more accurate workers to added efforts may, in the end, counterbalance the injury thus inflicted on an important industry.

After the above declarations and considering the time that has elapsed, the author hopes that he may be allowed to present some further results obtained by use of the driving spray without thereby becoming associated in your minds with some of the extravagant claims that have been made for this method.

In the previous paper, the writer showed that the continuous use of the driving spray has reduced the number of worms per tree in the ... orchard each year below that of the previous one until they were so few in number that it was impossible to use the orchard for ...r experimental work. A search was then made for a commercial

orchard sufficiently wormy for satisfactory use. But by this time practically every commercial orchard in the vicinity was well sprayed.

In the meantime, in an adjoining county, a number of young commercial orchards were growing up in the midst of old, mixed and exceedingly wormy ones. Work was therefore postponed until these orchards came into good bearing. Last season three of these orchards were selected for use. They were located, in a triangle, approximately fourteen miles apart, on different sides of a valley and representing different climatic conditions. They were all extremely wormy, as the records will show, but varied in the number of worms and the number of apples per tree sufficiently to represent three different conditions of infestation.

As many of the methods used in this study have been criticised in recent papers before this society, it seems necessary to discuss methods before discussing results obtained by their use. The writer has prepared another paper on the subject of "Methods in Codling Moth Study" to be presented later, which deals with these matters at length and to which the reader is referred for extended discussion of these questions.

The following suggestions and conclusions taken from this paper will be helpful in studying the results here presented.

1st. The driving spray, as presented by the writer, is a method of spraying, and not the result of the use of certain apparatus. Its three essentials are, *power* sufficient to drive into the calyx cavity, *position* above tree so as to be able to direct the spray straight into each blossom, and *perseverance* in application until every single blossom on every tree in the orchard has been properly treated.

2d. That all results presented by the writer are from that method. Comparisons have been made between sprays, but not between methods.

3d. Accurate comparison of methods is well nigh impossible, at least until considerable work has been done in standardizing apparatus and testing mechanical efficiency of nozzles, etc., under different pressures and at different distances.

4th. The driving spray method does not advocate any particular numbers of sprays; from one to five are found necessary under different conditions. It, however, does advocate a less number and a higher individual efficiency than previously employed. Likewise, it does not advocate any particular amount of poison, though, in the writer's experience, the highest efficiency has not been reached with less than four pounds of lead arsenate to 100 gallons.

5th. Two distinct systems of checking are in use. 1st, the unsprayed plot, which may be located at one end, or in the center. If at one

... may not represent the average of the orchard. If in the center, ... may endanger the value of surrounding experiments. This sort ... check most nearly represents the value of spraying as against no spraying, but cannot be used when the value of a given spray on a given brood is to be measured, as it greatly magnifies the value of inefficient spraying and of all second brood results. Under this system, ... is impossible to continue experiments on the same orchard through a series of years, as there will be too great inequality in distribution. 2d, the single check, so-called, distributed throughout the orchard. This method gives the most accurate indication of real orchard conditions in the first brood possible, and by banding these checks and thus destroying one-half to two-thirds of the first brood of worms, part of the remainder will scatter so that these trees will represent very nearly the condition of the orchard in the second brood. This system will not show the value of spraying as compared with no spraying. The scattering worms from the checks will tend to decrease the real efficiency of the sprays on the second brood, while the few extra worms these trees may carry more than a sprayed tree, will serve to heighten the apparent value of the spray, so that the second brood results will not be far from correct. This system also allows of the continuous use of the same orchard.

6th. Percentage of wormy fruit is a much less reliable basis of comparison than worms per tree, though neither one is entirely accurate and both should be given. Percentage of efficiency is the only method of statement by which different experiments can be compared and such efficiency can only be accurately measured by the single check system.

7th. That records founded upon picked fruit only are untrustworthy and practically valueless for scientific purposes. That postal card canvasses, etc., to determine efficiency are absolutely worthless and often misleading.

8th. That, in all tests of efficiency, absolutely accurate account should be kept of every fruit that sets on the tree and that the work of the different broods of worms should be kept separate and compared.

9th. That the number of broods and the relative importance of each brood in the total injury will greatly influence the efficiency of a given method or the importance of a given spray.

Plan of the Experiment. Each orchard as a whole was given two ... sprayings, and one or two late ones, with the exception of the experimental trees. Each orchard contained at least three varieties. ... on each variety two different spraying compounds were tested, ... in two different strengths, making twelve duplicate tests in each orchard of each spray. The averages presented are therefore based

on nine separate tests and these tests were again duplicat[illegible] four poison series, making thirty-six separate tests in all for [illegible] spray used. Three early sprays were used separately and in com[illegible]tions of two, making six different spray sets besides the unspr[illegible] one or seven sets in each orchard on each variety.

The lead arsenate (5 lbs.) was used as the standard of effic[illegible] and the results with this poison were so high that it was thought w[illegible] while to present them to the society as indicating the efficiency o[illegible] method of spraying, even under the adverse conditions expl[illegible] below.

The Orchards Used. The Stillman orchard (S) was the fir[illegible] blossom and the first sprayed. It did not have enough trees o[illegible] one variety to carry on all of the tests, so that half strengths an[illegible] third spray were omitted. In addition to the varieties used in [illegible] other orchards, Rome Beauty was added to these tests. A frost [illegible] the larger part of the crop, leaving the distribution very irreg[illegible] some trees having nothing left, and some Winesaps running as hig[illegible] as 2,500 apples. The check trees averaged 475 apples.

The Woodbury orchard (W) was sprayed next, as in the other t[illegible] orchards, the tests were carried on, on Gano, Jonathan and Wine[illegible] trees. Frost reduced the crop here even below that at the Stillm[illegible] orchard. The check trees averaged 325 apples.

The Nokes orchard (N) was last sprayed and it was a little late [illegible] the time this orchard was reached, some of the earlier calyx cu[illegible] closing. The Gano trees in this orchard were bearing from 1,000 t[illegible] 2,200 apples, the other varieties considerably less, with an average for the checks of 700 apples.

Poison Used. The poisons used were a standard lead arsenate (L. A.) and a new compound (N. C.)[1] each used in two strengths; five pounds and two and one-half pounds, to the hundred gallons. The N. C. did not prove efficient, especially in the two and one-half pound strength, and allowed too many worms to escape. These spread to the L. A. rows in the second brood, and lowered the apparent efficiency on the side worms. In the Woodbury orchard, where a greater amount of the two and one-half pound strength was used, and where the trees were bearing a very light crop, this effect was especially noticeable, often reducing the apparent efficiency on the total wormy [illegible]. This is only apparent, however, the real efficiency on side worms was no doubt as high as in any other case, as the remarkable calyx efficiency shown under these conditions indicates that very thorough spraying was done.

[1] It was through the financial assistance of the manufacturers of this comp[illegible] that this spraying experiment was undertaken.

Number of Worms. In the last section of the table the average of the five unsprayed checks for each orchard is given. In the first brood the unsprayed checks in the Stillman orchard had an average of 231 worms per tree, or 48 per cent wormy. Taking the average of the counted trees as the average of the orchard and this number of worms per tree would make the average for the orchard 65 per cent.

The Woodbury orchard had 120 worms per tree in the first brood, or 50 per cent wormy, or, on the average of all trees counted, 37 per cent wormy.

The Nokes orchard had 100 worms per unsprayed tree in the first brood, or 16 per cent wormy, or, on a basis of the average of all the counted trees, 14 per cent wormy.

Counting the second brood as ten times as great as the first, which is conservative for western conditions, we would have had the following condition in these orchards if there had been no spraying done.

Orchard	Average number of apples per tree	Average per cent wormy in first brood	Expected per cent wormy in second brood if unsprayed
[illegible]	475	65%	650%
[illegible]	325	37%	370%
[illegible]	700	14%	140%

Instead of this, the check trees were banded and from ½ to ⅔ of the first brood worms captured, and of the remainder, we would expect a considerable portion to scatter from the five unsprayed trees to the 600 or more sprayed ones surrounding them, and yet these unsprayed trees in the Stillman orchard were 85 per cent wormy and in the Woodbury orchard practically all wormy (92%). Of the few sound apples remaining some fell early and some few were down underneath the dense foliage of the centers of the trees and thus escaped, while most of the apples on the outside of the trees had three or more worm holes in them.

In the Nokes orchard, where the first brood was small, only two-thirds of the apples on the unsprayed trees were wormy and only a few had more than one worm. Even after the banding and scattering, we notice an increase of nearly four times between the first and second brood in this orchard. It would of course be impossible to get an increase in the other orchards, as they were half wormy in the first brood.

It is interesting to note that over four-fifths of the first brood worms went in at the calyx. It is not possible to make similar comparison

in the second brood, except in the Nokes orchard, because in the other orchards, there were more side worms than apples and many of the calyx wormy apples also had side worms.

High Efficiency of the 5 lb. L. A. Spray. The first three divisions of the table show combinations in which the first spray was applied. A glance down the calyx wormy column of the first brood shows that even under the extremely wormy conditions prevailing, the 80 per cent of worms that went into the calyx ends practically all perished, giving an efficiency of 99 or 100 per cent in every case. Even in the second brood with the number of worms increased many times, the lowest calyx efficiency is 95%[2] and the average almost 98% while the year total is 99%.

SUMMARY OF RESULTS OF DRIVING SPRAY TESTS, 1911

(Using Lead Arsenate 5 lbs. to 100 gallons)

Orchard	Averages per tree: Total apples	% wormy: 1st B.	% wormy: Yr.	1st brood Calyx: Wmy.	1st brood Calyx: Eff.	1st brood Total: Wmy.	1st brood Total: Eff.	2d brood Calyx: Wmy.	2d brood Calyx: Eff.	2d brood Total: Wmy.	2d brood Total: Eff.	Yr. total Calyx: Wmy.	Yr. total Calyx: Eff.	Yr. total Total: Wmy.	Yr. total Total: Eff.	1st 2d
W . . .	257	3	28	0	*100*	8	*93*	2	*98*	66	*35*	2	*99*	74	*67*	[illegible]
N . .	464	1.4	10	0	*100*	1	*99*	7	*97*	43	*87*	7	*98*	44	*90*	
Average efficiency					*100*		*96*		*98*				*99*			
S . . .	378	1	10	0	*100*	5	*98*	1	*100*	33	*87*	1	*100*	38	*93*	[illegible]
W . . .	446	5	35	1	*99*	23	*81*	1	*99*	133	*0*	2	*99*	156	*30*	
N . . .	446	1.2	6	1	*99*	2	*98*	3	*99*	27	*92*	4	*99*	29	*93*	
Average efficiency					*99*		*92*		*99*				*99*			
S	533	7	27	0	*100*	36	*88*	5	*98*	109	*55*	6	*99*	145	*74*	[illegible]
W . . .	365	12	40	1	*99*	42	*65*	4	*95*	118	*0*	5	*97*	190	*14*	
N . .	895	1.2	5	0	*100*	4	*96*	10	*96*	42	*87*	10	*97*	46	*89*	
Average efficiency					*100*		*83*		*96*				*98*			
W . .	300	4	37	3	*96*	13	*80*	26	*67*	98	*4*	29	*82*	111	*50*	[illegible]
N . . .	862	4	32	30	*62*	38	*62*	138	*42*	237	*28*	168	*47*	275	*36*	
Average efficiency					*79*		*70*		*55*				*65*			
S	215	11	40	9	*97*	*23*	*93*	25	*88*	64	*73*	34	*93*	87	*84*	[illegible]
W	258	12	53	10	*87*	34	*72*	29	*64*	107	*0*	39	*75*	141	*36*	
N . . .	467	9	34	24	*69*	42	*58*	74	*69*	119	*64*	98	*69*	160	*62*	
Average efficiency					*84*		*74*		*74*				*79*			
W	375	22	72	42	*47*	82	*32*	117	*0*	184	*0*	159	*0*	266	*0*	[illegible]
N	674	9	40	48	*58*	63	*37*	142	*41*	208	*36*	190	*40*	271	*37*	
Average efficiency					*53*		*35*		*21*				*20*			
S	650	48	85	263		311		202		241		465		552		[illegible]
W	242	50	92	79		120		80		102		159		222		
N . . .	617	16	69	78		100		240		327		318		427		

[2]This 95% efficiency is obtained by subtracting the average of 4 wormy on the sprayed trees in the (W) orchard from the 80 on the unsprayed trees, leaving 76 killed out of 80, or 95% killed.

. is one of the highest records of efficiency ever published and . . the wormiest conditions in which a brood separation has ever . . made. To my brother, Mr. W. M. Ball, who had charge of . . work, must be given the credit of this record.

. . second three divisions show combinations in which the first . . was omitted. A glance is sufficient to show the striking differ- . . in the number of worms and efficiency.

. comparison of the first spray only (1 0 0) with the second only . 1 0) gives a fair estimate of the relative importance of these two sprays. The orchards are everywhere arranged in the order in which . were sprayed. The second spray was a little too late for the . effect on the later sprayed orchards, as some of the calyx cups . entirely closed. A comparison of the three orchards shows a steadily decreasing efficiency as the calyx cups closed.

The second spray is never used alone. Its place is supplementary to the first one where conditions are bad enough to warrant it. It will be observed that the 1 0 1 spray was slightly better in the first brood than the 1-1-0, but that in protecting the calyx in the second brood, the reverse was true, while the side wormy would be taken care . by late sprays.

These orchards, with the exception of experimental trees, received two early sprays and two late ones. The late sprays materially re- . the number of side worms in the second brood.

Efficiency of the $2\frac{1}{2}$ lb. L. A. Spray. The table of the $2\frac{1}{2}$ lb. L. A. spray is almost a repetition of the 5 lb. one, with the number of worms everywhere slightly increased and the efficiency correspondingly lowered. The change is small in the first brood but becomes much larger in the second, where it equals 10 to 20 %. This confirms previous experiments showing that under wormy conditions 4 lbs. of lead arsen- . is the least that should be used.

PRESIDENT F. L. WASHBURN: The next paper will be read by E. P. F. of Albany, N. Y., on "Recent Experiments with the Codling Moth," and at its close both papers on this insect will be discussed.

RECENT EXPERIMENTS WITH THE CODLING MOTH

By E. P. FELT, *Albany, N. Y.*

. . experiments detailed below are a continuation of a series begun . in an effort to test the actual value of the various methods of . ing, so far as Hudson valley conditions are concerned. The . practice of orchardists was followed, the aim being to cover the

entire tree and especially to hit the tips of the young apples wi... poison. The apparatus was a good type and in each instance be... to the owner of the orchard, he also providing the men. Eac... consisted of approximately 42 trees, six trees in a row one wa... seven in a row the other way, the central six being the actual ... mental trees. The work the present season was limited to ... the value of one application made just after the blossoms fall ... pared with another plot which received in addition, a second spr... three weeks later, a third plot receiving in addition to the two spr... ings mentioned above, another the last of July. A fourth plo... given but one application about three weeks after the blossoms... There were, in addition, check trees. These latter, two in num... were placed between or near those of the four trees or therea... representing plot 4, this being the only exception from the arrange... of plots outlined above.

The experiments in series 1 were conducted in the young orch... of Mr. W. H. Hart near Poughkeepsie. It is located on a modera... high hill, the trees being thrifty, about seventeen years old, 18 to 2... feet high and 30 feet apart. All of the experimental and ... trees were Baldwins, the former being carefully selected for uniform... in size, fruitage and infestation. The fact that there was a variati... of only about 4,000 apples in the yield of the six experimental tr... of three plots, shows a fair degree of uniformity. The spray appl... consisted of $7\frac{1}{2}$ lbs. of Grasselli's arsenate of lead (15% arse... oxide) and $4\frac{1}{2}$ gals. of a concentrated lime-sulphur wash (31° Baumé) to each 150 gallons. The pressure was maintained at from 150 to ... pounds. The spraying was from the ground, the hose being tied ... long bamboo rods and the nozzles were of the later Friend type wit... apertures which had been worn somewhat by earlier work with a lime-sulphur wash and the spray was therefore rather coarse. The first application, made May 18, required only 150 gallons for 59 trees. The second spraying was given June 8 and the third July 26.

The experiments outlined above in series 1 were duplicated under series 2 in the orchard of Mr. Edward Van Alstyne at Kinderhook, the trees being older, somewhat more crowded and therefore not so easily sprayed. Plot 1 consisted of greenings, the others were ... Baldwins. There was a greater variation in the yield from the six experimental trees of the three plots, this being about 14,000 apples. The treatment was substantially the same as in the preceding series, except that lead arsenate ($15\frac{1}{2}$% arsenic oxide) manufactured by the Interstate Chemical Company was used at the rate of 15 lbs. to 250 gallons of water and a concentrated home-made lime-sulphur wash (27° Baumé) was used at the rate of 1 gallon to 25 of the spray. The

plication began May 23d and, owing to unfavorable weather, was completed till the 25th. The second application was given ... and the third July 29. A power spraying outfit was used as ... preceding series and a tower employed, one man being located ... and the other with an extension nozzle operating from the ... There was probably considerably more spray material ... per tree than in the preceding series. The blossom ends were sprinkled but there was practically no penetration of the poison to ... calyx cavity. The leaves were well covered with the spray ... fairly flooded.

... results obtained in these two series are at least fairly uniform ... well shown in the following summary of the plots.

SUMMARY OF PLOTS, 1911

Plot	Total fruit	Clean fruit		Wormy fruit				
		Total	Per cent	Total	Per cent	End worms	End and side worms	Side worms
1	16,638	16,515	99.26	123	.74	39	12	72
2	19,994	19,903	99.54	91	.46	5	[illegible]	[illegible]
3	20,926	20,830	99.54	96	.46	17	2	77
4	8,969	8,393	93.57	576	6.43	186	95	295
Check	5,337	4,540	85.06	797	14.94	379	166	252
1	20,802	20,401	98.07	401	1.93	28	14	359
2	34,019	33,510	98.50	509	1.5	53	54	402
3	31,119	30,852	99.14	267	.86	60	23	184
4	16,815	13,113	77.98	3,702	22.02	1,422	578	1,702
Check	14,670	9,860	67.21	4,810	32.79	2,048	949	1,813

A study of the summary of plots shows that conditions were fairly comparable in the two series, though the yield from the second was somewhat greater. The larger product of series 2 is, in some measure, offset by the trees being larger and more difficult to spray, an operation also hindered by interplanted plum and peach trees. The percentages of sound fruit from the plots in these two series show a fairly uniform increase with additional sprayings, though in the case of series 1 there is no difference between the percentage of sound fruit produced by plots 2 and 3, each yielding 99.54. There is, however, a nearly uniform gain in series 2, of $\frac{1}{2}$ of 1% from each spraying after the first. There is a marked contrast between the amount of sound fruit produced on plots receiving one treatment just after the blossoms dropped and similar plots sprayed three weeks later, the benefit resulting from the treatment ranging from $\frac{1}{3}$ to $\frac{2}{3}$ that of the early spray. An exam-

ination of the data relating to end wormy apples shows an interesting condition; in series 1, plot 1 there were 31; plot 2, 8; plot 3, ... plot 4, 281 and on the check trees 545. It will be noted that the decrease in wormy apples resulting from the various sprayings is very largely in the end wormy, while the poor results following the late spray must be attributed in considerable measure to failure in destroying the young caterpillars entering the blossom end of the apple. The large number of end wormy on the check trees gives an idea of the insect's preference for this point of attack. This is even better illustrated in the data for series 2. Plot 1 has 42 end wormy; *plot 2, 107; plot 3, 83; plot 4, 2,000, while the check trees produced* 2,997.

Incidentally, it may be well to call attention to a development in the spraying of plot 1, series 1. The day was showery and spraying of the actual experimental trees of this plot was finished by 1.40. A sprinkling of rain began a minute before and was rather lively before the work was completed at 1.46, the rain stopping at 2 p. m. The leaves at this time were partly flooded but there was no marked dripping. A subsequent examination of the experimental trees showed that in plot 2, sprayed some 10 minutes before the rain began to fall, there was very little or no washing, while in plot 1 those trees which had been completed just a few minutes before or at the beginning of the shower showed some washing, though this was limited largely to the carrying of the poison to the lower edge of the leaf where it settled in large drops. There was very little dripping and probably nothing was washed from the blossom ends of the young fruit. Despite the fact that the spraying of one experimental tree in plot 1 was completed in the beginning of a brisk shower, there was no marked variation in the percentage of sound fruit, the record of the various trees of this plot ranging from 99.11 to 99.41.

It is impossible, after scrutinizing the above figures, to escape the conviction that the first spraying within a week or ten days after the blossoms fall, is by all odds the most important so far as preventing wormy apples or controlling the codling moth is concerned. Manifestly, under the conditions obtained in series 1 and 2, the benefits resulting from the second and third applications are comparatively slight and of themselves would hardly justify additional treatment, unless it be advisable to spray for fungous diseases of one kind or another.

A study of the data obtained during the three years this investigation has been in progress, shows that a single spray gave averages for the various plots from 82.08 to 99.26% of sound fruit, or an average of 97.23% for the three years, if comparisons are made between ...

number of plots in each year. Reference to earlier published data shows that the low percentages occurred in 1910, a season remarkable for the unusual abundance of the second brood and one presenting different conditions which were greatly accentuated by the small size of the experimental trees. Excluding the data for this year, the lowest average percentage of sound fruit for one plot was 97.52. Incidentally, it may be well to note that less than ½ of 1% (.394%) of the wormy fruit from trees sprayed but once were end wormy.

SUMMARY OF THREE YEARS' WORK WITH THE CODLING MOTH, 1909-1911

Treatment	Plot	Series	Year	Total Fruit	Clean Fruit Total	Clean Fruit %	Wormy Fruit Total	Wormy Fruit %	End wormy	End and side wormy	Side wormy	% end wormy
[illegible]		1	'09	30,177	29,818	98.81	359	1.19	33	18	308	
		2	'09	21,264	21,042	98.96	222	1.04	23	18	181	
		1	'10	1,839	1,664	90.48	175	9.52	16	21	138	
		2	'10	8,135	6,677	82.08	1,458	17.92	160	27	1,271	
		1	'11	16,638	16,515	99.26	123	.74	19	12	92	
		2	'11	20,802	20,401	98.07	401	1.93	28	14	359	
Total and %				98,855	96,117	97.23	2,738	2.77	279	110	2,349	394
[illegible]		1	'09	10,316	10,206	98.93	110	1.07	4	7	99	
		1	'09	19,275	19,084	99.01	191	.99	10	9	172	
		1	'10	2,846	2,756	96.84	90	3.16	6	1	83	
		2	'10	7,316	6,105	83.45	1,211	16.55	127	10	1,074	
		1	'11	19,994	19,903	99.54	91	.46	5	3	83	
		2	'11	34,019	33,510	98.50	509	1.5	53	54	402	
Total and %				93,766	91,564	97.65	2,202	2.35	205	84	1,913	308
[illegible]		1	'09	9,680	9,582	98.99	98	1.01	8	10	80	
		1	'09	7,710	7,633	99.00	77	1.00	6	3	68	
		1	'11	20,926	20,830	99.54	96	.46	17	2	77	
		2	'11	31,119	30,852	99.14	267	.86	60	23	184	
Total and %				69,435	68,897	99.22	538	.78	91	38	409	185
[illegible]		2	'10	7,594	4,355	57.35	3,239	42.65	1,485	326	1,428	
		1	'11	8,969	8,393	93.57	576	6.43	186	95	295	
		2	'11	16,815	13,113	77.98	3,702	22.02	1,422	578	1,702	
Total and %				33,378	25,861	77.47	7,517	22.53	3,093	999	3,425	12.26
[illegible]		1	'09	3,251	2,366	72.73	885	27.27	312	302	271	
		2	'09	7,015	5,127	73.08	1,888	26.92	674	630	584	
		1	'10	711	202	28.41	509	71.59	186	240	83	
		2	'10	2,000	593	29.65	1,407	70.35	700	324	383	
		1	'11	5,337	4,540	85.06	797	14.94	379	166	252	
		2	'11	14,670	9,860	67.21	4,810	32.79	2,048	949	1,813	
Total and %				32,984	22,988	68.78	10,296	31.22	4,299	2,611	3,385	20.95

The six plots receiving two applications during this period produced from 83.45 to 99.54% of sound fruit or an average of 97.65%. The end wormy constitute about $\frac{1}{3}$ of 1% (.308%). The average gain during this period resulting from a second application was less than $\frac{1}{2}$ of 1% (.12%) which was accompanied by a slight reduction in the percentage of end wormy. It was unfortunate that in 1910 no plots received three applications and, as a consequence, the average percentage for this group is 99.22 of sound fruit, a yield undoubtedly relatively higher than would have been the case if two plots for 1910 could have been included. Even with this omission which, in a measure at least, is favorable to three applications, the average percentage gain between two and three treatments is only 1.57%. There is, however, a marked reduction in the percentage of end wormy, it amounting to only .185%.

The three plots receiving one late application during 1910 and 1911 gave an average percentage of sound fruit of only 77.47, there being a variation between individual plots from 57.35 to 95.57. The average percentage of sound fruit for these plots is approximately midway between that obtained from one spraying just after the blossoms fall and the yield on the check trees. The percentage of end wormy (12.26%), is a great increase over that in the preceding plots and shows in a convincing manner where this late spray lacks efficiency.

The check trees during this period gave an average percentage of sound fruit of 68.78, the yield varying in individual plots from 28.11 to 85.06. The small yield of good fruit, it should be noted, occurred on trees producing relatively few apples. The average percentage of end wormy fruit for these plots is 20.95, a great increase in the average for the plots receiving one late spraying and very different from the data from sprayed plots where the greater number of wormy apples have been injured by the second brood and are therefore side wormy.

A study of this data as a whole justifies the conclusion for the Hudson valley at least, that in normal years when the crop is abundant or fairly abundant, one thorough early spraying, namely, within a week or ten days after the blossoms fall, should result in the production of 95 to 98% of sound fruit. A slight gain will accrue from a second treatment about three weeks later, and an additional gain from a third spraying given the latter part of July. The benefit from the latter two is comparatively small, so far as the codling moth is concerned, though ample to meet the cost of the poison and, in many instances, probably the expense of treatment. Should there be sufficient fungous disease to warrant applications for this purpose, there

e no question as to the advisability of adding poison in the ... sprayings.

... all crop almost invariably means a larger percentage of wormy ... and if the prospects are even fair for good prices, the third spray- ... (latter part of July) would at least justify itself because of the ... protection from possibly severe injury and consequent ... the second brood. The second spraying, namely, three weeks ... the blossoms fall, might be advisable especially if the first appli- ... was not thorough for some reason or other.

PRESIDENT F. L. WASHBURN: Mr. Quaintance is down to discuss Doctor Felt's paper, and I will now call on him.

A. L. QUAINTANCE: Doctor Felt is to be congratulated on the accomplishment of so large an amount of experimental work in testing spray applications against the codling moth. His experiments have extended over a period of three years, and during two seasons, tests have been made in duplicate. A large amount of data has thus been secured and it constitutes an important addition to our knowledge of the subject.

Anyone who has given attention to experimental work with sprays against the codling moth will appreciate how difficult it is to arrange for such work under even fairly satisfactory and uniform conditions, as in obtaining a sufficient number of trees of one variety and of the same size and fruiting capacity; in effecting the proper arrangement of the plats, and the selection and locating of suitable trees for making counts of the fruit. It is always difficult to obtain from the orchardists permission to leave untreated for purposes of comparison an adequate number of trees. Weather conditions also much modify the results as affecting the character of spraying which may be done, and efficiency of sprays subsequently. To obtain conditions during a second and third season, essentially the same as those of the first, is much more difficult. Doctor Felt in his three years' experiments seems to have been able to overcome these difficulties fairly well, though conditions have varied somewhat, especially as regards the varieties used, the age of trees, the strength of the arsenical, and also in the manner of making applications.

During the past six or eight years, a good deal of experimental work has been done in the use of sprays against the codling moth. This may be grouped approximately under two headings, namely:

Work done by western entomologists, under arid conditions.

Work done by eastern entomologists, under humid conditions.

Some of this activity on the part of eastern entomologists, has

followed certain caustic but we are assured well-meant criticisms on the part of our western co-workers. More or less of controversy has arisen, and this has centered principally on two questions. Stated chronologically these are, first, the necessity or not of filling the inner calyx cup; and second, the sufficiency or not of the so-called one-spray method. Doctor Ball of Utah was the first to point out the importance under western conditions of spraying in such a way as to force the poison into the inner calyx cup; and the sufficiency of the one-spray method was advocated by Professor Melander a year or two later. Several eastern entomologists have now investigated these as well as other points in connection with the control of the codling moth under their conditions. It would now seem that sufficient information on the subject has been accumulated to warrant drawing general conclusions at least.

Filling the Inner Calyx Cup. Referring first to the matter of filling the inner calyx cup, it seems clear from the studies which have been made that a difference in behavior of the stamen bars, as respects their shriveling, must be admitted for the two regions under consideration. Several observers in the East agree that on certain standard commercial varieties, the stamen bars remain turgid and effectively protect the cavity below from sprays applied during the period that the calyx lobes are spread. The filaments begin to shrivel, it is true, as the calyx lobes are closing, but this does not occur for the most part until it is too late to do effective spraying. The turgid condition of the stamen bars was well shown by Slingerland (Journal of Economic Entomology, Vol. 1, p. 352), and Sanderson (19th to 20th Reports, New Hampshire Agricultural Experiment Station, pp. 443-448, on this point states: "As mentioned above, the sepals usually close about one week or at most ten days after the blossoms drop. At this time the stamens are still entirely turgid, and no spray can be forced between them, no matter how high the power or coarse the spray." From Mr. Lloyd's experience in Illinois (Ill. Sta. Bull. 114, p. 381), we infer a rather different condition as regards the stamen bars, as he was able with comparatively low pressure and a heavy spray, to poison the inner calyx cavity of a majority of the apples treated. It is not stated what variety of apples were used and whether the spraying was begun promptly after the falling of the petals, or some days later.

The experiences of several workers in the Bureau of Entomology substantiate on the whole the results of Professors Slingerland and Sanderson. Mr. Jenne in Arkansas however, during 1909, in the course of experiments on the one-spray method, was able in frequent instances to force a spray below the stamen bars. In the experience

of Mr. E. W. Scott, during 1911, in Michigan, the employment of high pressure and a coarse spray did not result in poisoning the inner calyx cup, except in occasional instances. It would appear on the whole that under eastern conditions, the spray is not forced to an appreciable extent below the stamen bars, though the extent to which this is done will vary with the age of the apples when treated, and perhaps with the variety in question; more information is needed on this point.

Relating directly to this topic is the question of whether it is *necessary* to place the poison in the inner calyx cup; it would appear, in fact, that such is not the case. Observations by numerous experimenters, as shown above, on a single application of a coarse spray, under high pressure, show that in but comparatively few cases is the posion forced into the lower cavity. The results from the one-spray are on the whole excellent and fairly uniform, which indicates clearly that the young codling moth larva feeds mostly in the outer calyx cavity. Specific confirmatory observations are at hand on this point, notably those made by Professor Slingerland (l.c.), and Professor Sanderson (l.c.).

The One-Spray Method. The above considerations relate closely to the one-spray method. Data on the efficiency of a single application after the falling of the petals is tabulated below:

SUMMARY STATEMENT ON RESULTS OF ONE-SPRAY METHOD AGAINST CODLING MOTH AND PLUM CURCULIO

Experimenter	Codling Moth: Sprayed once. Per cent sound.	Codling Moth: Unsprayed. Per cent sound.	Plum Curculio: Sprayed once. Per cent sound.	Plum Curculio: Unsprayed. Per cent sound.
[illegible]	91.60	45.80		
[illegible]	97.40	65.90	87.50	67.90
[illegible]	97.23	68.78		
[illegible]				
[illegible] 1909	84.07	53.02	73.96	71.02
[illegible] 1909	91.68	54.00	77.99	37.23
[illegible] 1909	92.76	66.74	86.33	[illegible]
[illegible] 1909	93.61	77.79	97.53	87.42
[illegible] 1911	92.83	43.40	85.69	65.15
[illegible] 1911	84.15	30.20		
[illegible] 1911	87.05	52.73		
[illegible] 1910	99.01	84.49		
Averages	92.86	58.44	81.15	51.76

In 8 of the 11 experiments, the percentage of sound fruit is a… 90. In one instance (Va. '09), the lessened efficiency of the trea… was due to the effect of a serious hail storm greatly favoring th… entrance of the fruit by the larvæ. Spraying results must, of co… be considered in connection with the severity of the insect. … percentage of sound fruit on the untreated trees of the resp… experiments is shown for comparison. The average of the percen… of sound fruit for the one-spray method for all localities is 92.8… compared with an average of 58.44 per cent of sound fruit o… untreated plats.

A few workers have also made observations on the effect of th… spray method in controlling the plum curculio. A surprising d… of efficiency has been obtained by a single spraying as the petal… and can only be accounted for on the supposition that pract… all the beetles are out and feeding at that time, and thus are pract… exterminated. The average percentage of fruit free from cu… injury for the several experiments in which this point is reporte… 81.15 as compared with 51.76 per cent of sound fruit on untr… plats.

An interesting question comes up in this connection. Many rec… on unsprayed trees show that from two-thirds to three-fourt… the first brood larvæ of the codling moth enter the fruit at the c… end. Assuming that all of the young larvæ entering the calyx … killed, there still remains some 25 to 30 per cent of larvæ which … mally enter the fruit at the side. Based upon the percentage of so… fruit obtained, these also have been destroyed. Perhaps suffic… spray from a single application remains on the foliage and fru… destroy the young larvæ as they are hatching some three or four w… later.

Notwithstanding the excellent showing made by the one-s… method, it is another question under Eastern orchard condi… whether its use should be recommended. The necessity for se… applications of fungicides adds but little to the expense of ma… additional treatments with arsenicals. If plant pathologists sh… be able to reduce fungicidal applications to one treatment, follo… the dropping of the petals, there is no question but that the one-s… method would come into large favor by orchardists, but it shoul… remembered that the results, above indicated, have been obtaine… the course of experimental work where particular attention was g… to thoroughness: while such results could, of course, be secure… orchardists, they will, for the most part, fail to obtain such a … percentage of sound fruit. I do not believe that entomologists w… at present be justified in radically changing present spraying sche…

... codling moth, though orchardists should be made fully ac...d, for adoption or not, with the results following one thorough ...ation.

...tor Felt presents data on another question, concerning which ... has been more or less uncertainty, namely, the value of the ...ment given three or four weeks after the falling of the petals and ... the codling moth larvae are hatching in maximum numbers ...rson, who gave considerable attention to this point ... con... as the result of his tests that as regards the value of the third ...ing (2nd) the only conclusion possible is that if no rains occur ... spray I, that application of Spray III will be of doubtful value ... unsprayed trees show not over 50% worminess for the season. ... treatment, it will be noted, is considered in connection with the ... treatment, and Doctor Felt's conclusions, and our own, agree ... with those of Professor Sanderson. When the first spraying ... been omitted or imperfectly made, a second application shows ... much better advantage, though it does not by any means overcome ... worminess due to missing the first treatment. In Doctor Felt's ... to determine the value of this application alone, his final average ... sound fruit for three seasons is 77.47 as compared with his final ...rage of 68.78 of sound fruit from the untreated plats. There is ... a difference in favor of a single application of about 10 per cent. According to Professor Gossard, this single treatment gave a percentage ... sound fruit of 61.50, as compared with 45.80 per cent sound fruit ... sprayed trees, representing a saving of 15.70 per cent of the crop. ... influence of still later treatments as against the second brood is ...parable to that just cited, and their value varies in proportion to ... thoroughness with which the first application was made. Its ...ect is largely against the young larvae before they have entered the ..., although as shown by Lloyd, a good many larvae may succumb ... the effect of poison sprayed on the fruit, after they have actually ...ed beneath the skin. Doctor Felt's conclusions seem amply justi...d from the data presented and his conservatism in still recommending ... usual three treatments for the territory considered by him is ...mmendable.

President F. L. Washburn: We would be very glad to hear from ... one else. We ought not to limit discussion of this codling moth ...estion.

T. J. Headlee: I have been tremendously interested in the paper ... in the remarks that have followed it. We have completed two ...s of tests, comparing the mist with the dash spray. In the course ... our work, we saw that the nozzle which Mr. Ball showed was too

small, and used a larger one, but it didn't seem to give a satisfactory dash spray. That is, the drops broke and became too fine, and so we simply turned the hole free of the edge of the nozzle and shot a solid stream, which ran something like five or six feet before breaking up, using about sixteen gallons of fluid to the tree. We did that year before last. This last year we took the regular Bordeaux nozzle and shoved it over so as to make the edge of the hole catch the edge of the nozzle holder, and thus throw a fan-shaped spray, like that Mr. Ball has described. Both years we examined the calyx very carefully to see if we got any poison into it. These examinations, I am sorry to say, revealed a very small percentage of penetration, and when I worked up the summary of the two years' results, I found but little in favor of the dash, as opposed to the mist spray. Now, in order that you may understand the nature of the data upon which these statements are founded, I will say that our experimental plats were, in all cases, five rows wide; that the trees for count were taken from the middle row of each plat; that the check plat was, the first year on one side of the orchard, and, the next year, on the other side of the orchard. We used the check-plat method. Of course, our check plat was the same size as the others, and we made our counts in the same way. We took into consideration all of the fruit that set on the trees selected, and we counted from six to ten trees per plat. I am certainly inclined, from our small experience, to agree with the statement of Professor Quaintance, that, in all probability, the staminal ring retains its rigidity until the calyx is practically closed.

E. D. Ball: Mr. President, everyone is, I think, agreed that the first spray is the most efficient single spray that could be applied and lest someone misinterprets the tables presented, let me say that the second spray, or spray nine days later, is never used alone in actual field work, but only as a supplementary spray to the first one where the conditions demand it.

When we have reduced the worms to 2 per cent or less, we use only the first spray to keep them down. The point is, if the worms are reduced to 2 per cent, the efficiency of the one spray is high enough in connection with the added force of the enemies of the codling moth to keep the worms down to this point. If conditions demand more than one spray—one spray and then banding would be used; then two sprays and banding, and for bad conditions, two early sprays, banding, and late sprays are often necessary.

So that you may better understand the conditions that we are sometimes called upon to meet in the West, I would like to call your attention to a public statement of Prof. E. P. Taylor with reference to the codling moth, and, as I was also in these orchards with Professor

Taylor. I can also vouch for their accuracy. In the Grand Junction district, as the result of following the one spray and the one pound of poison propaganda, the number of worms increased until we found in one orchard as an average of a long series of counts 42 eggs to an apple. Gentlemen, think of what such a condition as that means. One spray with one pound of poison or ten pounds of poison would not touch such a condition.

On the other hand, if Doctor Felt's experiments were under similar conditions to those shown by Sanderson's tables, and they probably were, there were less worms to kill in the second brood than there were in the first. Under such conditions, any spray that is fairly efficient in the first brood would be sufficient. If a worm was left in the first brood, it might make half a worm in the second brood—not more, while, in the western results, you will notice they increased from 10 to 16 times between broods, and Professor Quaintance shows increases up to 80 and more times between the first brood and the second.

Now, under the conditions found in Grand Junction, eight sprayings did not produce sound fruit and thousands of bushels of apples fell to the ground wormy, for which boxes had been ordered and all preparations made to ship. All this as the results of a false propaganda of one spray and one pound of poison without regard to conditions. We do not want any of that in the West. And, yet, there were whole valleys in Utah this year in which there was not a single orchard sprayed more than once. But, if those orchards should get more than 2 or 3 per cent wormy at the end of any given year, the next year they would get more than one spraying. We do not talk one spray or two sprays, we talk thorough spraying and holding the worms down. You must keep in mind the difference in conditions out there and the conditions that Doctor Felt has been talking about. There are high freight charges on our apples, and in order that they may bring a profit, they must be absolutely sound. You must also keep in mind that the value of the western apples is their color, and the colored apples are the ones on the outside of the tree, and those are the ones most affected by the worms. Our efficiency must be five times what yours is to have anything like the same results, so do not understand that I am talking this spray for your people, but we have a condition to meet in the western country which we cannot afford to fool with. It is a fight to the finish with us and we have finished the codling moth where we have gone at it right.

Just one more thing, I made two mistakes in my first bulletin. I want to correct them publicly. I stated that I used 85 pounds pressure, and that was because the manufacturer said the pump furnished that. I had no gauge on the pump at that time. Since putting a

gauge on, I find that we have never used less than 120 pounds pressure. The second mistake was recommending a Seneca nozzle for the driving spray. I have never used one then and supposed that it was the same as the true Bordeaux. As soon as I tried one, however, I found my mistake and have been careful ever since to specify the large Bordeaux type and warn people against the small one.

I am somewhat surprised to find that some of you have had such success in driving the poison into the calyx cups. There seems to be no question about our doing it in the West, as I have frequently examined orchards with a hand lens and predicted in advance the success that would result from the spraying. These conclusions have been based on the amount of poison seen in the calyx, and have been repeatedly successful. I took a satchel full of apples to the Northwest Fruit Growers' Association, cut them open before the growers and put them under a microscope and showed the poison in the calyx cup over nine months after the last spraying.

E. P. Felt: Our experience has been that we could get poison down into the calyx cup better in the Hudson Valley just after the blossoms dropped, before the stamens shriveled to any extent, than we could later, because later the stamens appeared to bar out the drops of water. We used arsenate of lead, and made examinations for penetration immediately after spraying, and if any drops were seen we concluded that there had been penetration into the lower calyx cup. If not, we knew there had not been. We looked for the liquid before it had an opportunity to dry.

T. J. Headlee: I have been wondering if Mr. Ball made a study of the closing of the calyx cup in relation to the maintenance of rigidity of the stamens, whether in the West this staminate bar actually shrivels up and breaks down, before the closing of the calyx cup.

E. D. Ball: It is unfortunate of course that we do not have Baldwin apples in our western country. I think I have in this publication here a copy of a sketch in which is shown the relation of the shriveling of the stamens to the time of the closing of the calyx. At the time in our western apples that the calyx cups begin to close but are still quite open, the stamen bars are thick and fleshy and close together like the fingers of one's hand. At this time it is very hard to force a liquid through. Some can be driven through, however, by driving straight in through the center where they curve out. Later, when the green calyx lobes have come to a nearly upright position is the time that we do our best work provided the nozzle is held close enough and the spray driven straight into each one of these narrow funnels. By this time, the stamen bars, as you look at them from the side, have become curved and twisted and somewhat shriveled, as shown in this

figure, and there are many spaces through which liquid can be forced. It is a fact that last sprays in the fall of the year often do make considerable calyx good, as at that time the growing apple has again opened the calyx cup and more poison can be forced in.

I find that when I come to investigate the spraying of those that have not had good results previously, I usually find that they do not get their nozzles close enough to the blossoms and do not turn the nozzles around sufficiently to get a straight drive on every apple. If you miss a calyx on a western apple, you have a calyx wormy apple almost every time, so we do actually spray in the western country and we are satisfied that there is not one apple in one hundred on the trees that has not been driven straight into. This is not conceit on our part. You cannot get away from the facts presented in the records where we have had as many as four worms to an apple in some cases and yet as high as 99 per cent calyx efficiency. There is no question in my mind either but what the greater per cent of the killing is done in the lower calyx cavity. If you fill the top cavity and the stamen bars with poison, when they shrivel there is a considerable likelihood that some of the poison will be knocked off and dropped into the lower cavity, and increase the amount already driven there. It is also probable that we get a considerable efficiency due to the rearrangement of the poison on the trees during the summer. The poison that has been placed on the leaves and bark of the smaller branches and twigs will, as they rub together, tend to fall on the lower leaves and give a higher efficiency there than we get on the upper ones.

P. J. PARROTT: I am quite frequently confronted with some anomalous results in spraying for the codling moth in New York. I am at times surprised at the satisfactory returns obtained by some of our growers in spraying for this pest when considering how carelessly the work is performed. Then there are other orchardists who, in spite of careful spraying, experience considerable difficulty in obtaining a reasonable amount of protection. One of the great benefits that has been derived from the discussions in recent years upon methods of combating the codling moth is the emphasis that has been placed upon thoroughness of treatment. The discussion of this subject at Baltimore led me to make some tests to determine how far the spraying mixture penetrated into the center of the blossom part. We used a high-pressure spraying outfit and cochineal to stain the mixture but I was surprised how ineffective was our spraying as conducted in our usual fashion. It was apparent that we were not taking enough pains to treat all of the blossoms, nor were we using enough spray material. I have since encouraged our growers to use spraying mixtures more liberally and to spend more time with each tree. When the bordeaux

mixture was commonly employed there was comparatively little danger in drenching the foliage; but the lime-sulphur solution is largely used now, and because of the danger of "burning" the leaves we are confronted with the situation of advocating thorough spraying for the codling moth coupled with a warning to use the liquid in minimum quantities to avoid injuries to foliage.

PRESIDENT F. L. WASHBURN: Did you look for the cochineal in the ower calyx cup?

P. J. PARROTT: Yes.

PRESIDENT F. L. WASHBURN: And find that you didn't get that?

P. J. PARROTT: Well, I was surprised to find how little of the cochineal reached the lower calyx cavity. We failed to see it in the lower calyx cavities of most of the fruits. I should also like to say that we have an orchard of about thirty-five acres, said to contain upwards of 800 varieties of apples that I am supposed to keep free from insects. I take a great deal of pride in showing visitors the freedom of the trees from San José scale and various other insects, but I am constantly surprised at the number of wormy apples that appear. I am puzzled at my results and I have often wondered if some western entomologist could inform me how to reduce the number of wormy fruits. I attribute my failures to the mixture of varieties and the presence of neglected orchards in the neighborhood. There is no appreciable shrinking of the stamens, and it would be impracticable to attempt to reach the lower calyx cavity.

E. D. SANDERSON: I agree heartily with Professor Quaintance in this matter. There is one thing, it seems to me, the entomologists might stand for in the East, and that is to get away from this idea of spraying a week or ten days after the first spraying for the codling moth. A lot of spray pump companies and newspapers keep on insisting on that recommendation for the codling moth, but I think it ought to be three weeks after the first spraying, as far as the codling moth is concerned. I find a good many horticulturists recommending a week or ten days after the first spraying, but I don't believe in it.

P. J. PARROTT: The reason for that recommendation is that there is danger of a very late infection of apple scab, which sometimes makes that treatment advisable in New York.

SECRETARY A. F. BURGESS: Mr. President, I would suggest that, inasmuch as there are many good men in the western states who are thoroughly familiar with Doctor Ball's spraying method, that it might be a good idea for some of our eastern institutions to obtain one of those men as an assistant and try the method here in all its details. They certainly develop entomologists in the West, and I think it would be a very fine thing to have that tried out in the East

at some station where they need another assistant. Get a man, try it once and see if it is possible to secure better results.

A. L. QUAINTANCE: Mr. President, I am reminded by Mr. Burgess' remark that I have in my office force Mr. E. L. Jenne, who was for some years connected with the Washington Experiment Station and spent two years I believe, in a careful study of the codling moth in the State of Washington in connection with Professor Melander. I think, therefore, that Mr. Jenne is thoroughly familiar with western methods of spraying. He was in charge of the spraying operations at Siloam Springs, Ark., upon which the Bureau has reported. We therefore think in this case, at least, that the spraying was done by a true westerner.

W. H. GOODWIN: During the last few years our results in the spraying experiments in the Ohio Station orchard were variable. The differences in the number of wormy apples where the same kind of sprays were used and the same number of applications were given, was surprising and was due, we decided, entirely to varietal differences. There are only three trees of each kind in the variety orchard and the results obtained were very striking because of the wide range of variation of the percentages of wormy fruit. Some trees having less than twelve per cent wormy while another tree in the same plot but of a different variety had almost forty per cent wormy fruit.

PRESIDENT F. L. WASHBURN: It might be a good thing for the men interested in this subject to get together while we are in Washington and discuss this subject.

Adjournment.

Friday, December 29th, 10.00 A. M.

PRESIDENT F. L. WASHBURN: The first paper of the morning is by Glenn W. Herrick, of New York. "Notes on the Control of Three Shade Tree Pests." Mr. Herrick.

NOTES ON THREE SHADE TREE PESTS

By G. W. HERRICK, *Ithaca, N. Y.*

The Elm-Tree Leaf-Beetle (*Galerucella luteola*)

The splendid elm trees on the campus of Cornell University have been so badly injured during the past half dozen years by the leaf-beetle that measures of control became imperative if the trees were to be saved. Fortunately, the University authorities realized the gravity

of the situation in time and naturally turned to the Department of Entomology for help.

The problem seemed a rather large one and I was surprised to find how little definite data there really was to guide us in making an estimate of the cost of spraying shade-trees, or to give a really adequate idea of the kind of outfit to use, and the most economical and effective methods of accomplishing the work. We have nothing startling to offer in the way of new methods or apparatus, but we succeeded in spraying the trees with rather gratifying results in controlling the beetle and in a fairly economical manner. We hope, however, to improve the work during the coming season.

The first question that presented itself, of course, was the choice of apparatus. Our appropriation was not large and it, therefore, became necessary to limit ourselves to reasonably inexpensive but tried outfits. After much correspondence and several interviews with agents, we decided to purchase a Hardie Power Sprayer with triplex pump, 3 H.P. engine, 200-gallon tank, 12-foot tower, two leads of hose, each 100 feet long, and two extension poles, one 20 feet long and the other 12 feet in length, and a Friend Hilly-Orchard outfit with a 3½ H.P. engine, California model pump, 8-foot tower and other equipment like the former outfit. With these outfits, and both gave eminent satisfaction, we were able at all times to maintain 175 to 200 pounds (and over) pressure. One man remained on the tower and with his 20-foot extension pole and Bordeaux Nozzle was able to reach the tops of the very highest trees. The man on the ground ran the engine, drove the team, and sprayed the lower branches. The so-called foreman directed the work, mixed the solutions, attended to breakdowns, climbed trees if necessary, and kept things going in general.

The first spraying was made from May 16 to May 25 and the second from June 12 to June 22.

We used 3 lbs. of paste arsenate of lead the first time over the trees and 3½ lbs. to 50 gallons of water the second time.

A careful and detailed record of the actual cost of spraying 435 trees was kept. Most of these trees were large and all of them stood along the street and near our water supply. It cost $133.37 to spray these trees once or 30.7¢ per tree. On the average each machine sprayed 36¼ trees per day of eight hours, or 4½ trees per hour or a tree about every 13¼ minutes. On an average we used approximately 18¾ gallons of liquid to each tree.

A detailed example of a day's work on the largest trees will give even a better idea of the cost of spraying such trees. On June 19 the two machines began on the largest elms on the Campus, namely,

... from the Library south along each side of Central Avenue. The ... machines sprayed 59 of these very large trees. The cost of the ... teams was $17.00, the arsenate of lead $6.61½, the gasoline ... total $23.96½, which is an average of 40.6c per tree.

... there are about 530 trees on the University Grounds that ... sprayed. About 100 of these were scattered over the steep hill- ... of the buildings and along University and Stewart Avenues. ... of these trees were a mile from our water supply and the major- ... scattered and not easy to reach. It cost, exclusive of per- ... equipment, $461.90 to spray these trees twice or an average ... approximately 88c each. The scattered trees just mentioned ... the average cost of the whole, quite materially. If all of the ... stood along streets and reasonably near a water supply the ... cost would have fallen I think, below 70c. It took the two ... ten days to make the first spraying and eleven days to make ... second. The second spraying was done more thoroughly and ... much more leaf surface to cover. On the other hand, experi- ... made the men more efficient.

In conclusion of these notes on the elm leaf-beetle, I should like to ... work of *Sporotrichum globuliferum* in killing scores of the ... newly emerged beetles of the first generation in the latter ... July and first part of August, and a great majority of the ... the second brood in September.

The Elm Sawfly Leaf-Miner (*Kaliosysphinga ulmi*)

This miner is present at Ithaca and injures the English and Scotch ... very severely. Its life history and habits were investigated by ... Professor Slingerland and described in Bulletin 233 of the ... Experiment Station. No adequate method of control, how- ... had been found up to 1911, so far as I am aware.

Recalling the penetrating power of certain contact insecticides, it ... to me that possibly the larvæ might be killed in their mines ... leaves before they caused much injury. It was with a forlorn ... however, that I sprayed a small Scotch elm which had been ... injured.

The mixture consisted of Black-leaf-40 at the rate of one gallon to 800 gallons of water with four and one-half pounds[1] of laundry ... to 50 gallons of water. The application was made in May just as the tiny mines had begun to show in the leaves. The effect was ... surprising. I examined a great many of the sprayed leaves and every larva had apparently been killed within a comparatively short

[1] ... intended to use but two pounds of soap to 50 gallons but by a mistake ... calculation four and one-half pounds were used.

time, at least before the mine had been perceptibly enlarged. The contrast, later in the season, between the topmost branches, which we could not reach and the lower branches was very marked. The leaves not sprayed were almost completely mined and became withered and most unsightly.

Apparently the elm leaf-miner can be controlled by spraying with tobacco extract and soap. We shall have an opportunity to make much more extended trial of this method of control during the coming season.

The Larch Case-Bearer (*Coleophora laricella*)

I have been giving considerable attention to the life history of this pest on larches during the past two years together with an attempt to find a practicable and efficient method of control.

This insect passes the winter in its fall case attached to the branches of the tree. On April 7th, before the buds had begun to swell and before the larvæ had left their winter positions, we sprayed a badly infested tree with lime-sulphur at scale strengths. The lime-sulphur was the home-made concentrated and tested 29° Baumé. It was diluted 1 to 7 and the tree thoroughly coated from top to bottom. The next day there was a heavy fall of snow. The subsequent three or four days were clear and sunny.

By April 27th an examination of the trees showed that the buds had started and that on the unsprayed trees the larvæ had moved to the leaves. On the sprayed tree, however, not a larva had left its winter position. On May 5th I examined many larvæ and found only two alive. The others were dried up and dead. In subsequent examinations I was unable to find that a single larva had moved from its hibernating position to the leaves. It would seem that the lime-sulphur at scale strengths is highly efficient for this particular pest at least.

President F. L. Washburn: Discussion of this paper will come after Mr. Burgess' paper, "Some Shade Tree Pests in Eastern Massachusetts."

SOME SHADE TREE PESTS IN EASTERN MASSACHUSETTS

By A. F. Burgess, *Melrose Highlands, Mass.*

In few sections of the country have shade trees suffered more from the attacks of injurious insects than in Eastern Massachusetts. This region has not only had the usual number of native pests but from time to time several introduced, and very destructive foreign species

and lodgment and have caused more damage than they were accustomed to in their native homes. As a result of the threatened destruction of trees public interest has been stimulated in the matter and it is doubtless true that more work is now being done on shade trees in this section than in any other region of the same size in the United States.

Among the very serious European pests that have been introduced are the gypsy moth, the brown-tail moth, the elm leaf beetle, the leopard moth and the European bark beetle, (*Eccoptogaster multistriata* Marsh) which latter is causing enormous damage to elm trees, especially in Cambridge.

In the early nineties, when the gypsy moth was found in the suburbs of Boston, much interest was aroused in protecting shade trees and forests from this destructive pest, and as a result new methods were devised for carrying on warfare against this insect and excellent results were secured. During the summer of 1897, when this insect was under control and when its capacity for harm had been reduced to such an extent that it could be controlled by what would be now considered a moderate appropriation, it was discovered that another European pest, known as the brown-tail moth, had become established in the same region and was causing considerable injury. This discovery was most discouraging, owing to the fact that the annual expenditure for keeping the gypsy moth in check seemed to be as large as could be raised for such a purpose. Both insects, however, were fought by the best means that were then known and in 1900, when the State work was finally discontinued, they were under sufficient control so that no serious injury was being caused in the residential sections.

During the next four years these pests increased enormously and a large amount of damage resulted. In the meantime, however, their work, on the elm trees, was supplemented by the annual appearance of the elm leaf beetle, which caused permanent injury if no remedies were applied.

This condition stimulated the interest of the citizens throughout the affected section and much money was expended by private owners, as well as by some of the towns and cities surrounding Boston, for the purpose of protecting the shade trees within their borders.

After the State work was resumed in 1905 more attention than ever was paid to the protection of trees in the cities and public parks and although it has been confined strictly to fighting the gypsy moth and the brown-tail moth, it has aroused interest and caused many owners as well as many of the cities and towns, all of which are pro-

vided with official tree wardens, to protect the elms from the r of the elm leaf beetle.

The condition of the trees, at the present time, is a fairly go cation of the extent to which the citizens became aroused, but i cases work was not begun until after it was too late, and as a enormous damage and loss to the trees has been sustained.

The recent discovery about 1907, of the leopard moth, (Z *pyrina* L.) in Boston and vicinity and the finding of the Eu elm bark beetle in Cambridge are two of the most discouraging f of the campaign for the protection of shade trees in this region. of these insects work beneath the bark and the injury which the is inconspicuous until it has proceeded so far that it is diffi repair the damage, or to destroy or check the pests. In addi the insects already mentioned, it should be said that the San Jos is causing much injury to such shades trees and ornamental pl it particularly favors for food and that this damage is increasing than decreasing from year to year.

The tussock moth (*Hemerocampa leucostigma* S. & A.) occasio becomes abundant enough to cause serious injury, but the da sustained does not compare with that caused by the pests whic already been mentioned. Owing to the number of insects con and their different habits of life, it is impossible to lay down an rule for treatment which will be effective for all. The cheapes most satisfactory remedy for the gypsy moth and the elm leaf consists in thoroughly spraying the trees with arsenate of lead ten pounds to one hundred gallons of water, as early in the spr there is a sufficient foliage to hold the poison.

For this purpose high power spraying machines have been per during the past few years. The improvements made in these spr nozzles and other equipment have resulted from the experi conducted under the direction of Mr. L. H. Worthley, who has charge of the work on the gypsy moth for the State Forester of Mass-chusetts. Several improvements have also been made by Mr. D. M. Rogers, Superintendent of Moth Work, for the U. S. Bure Entomology.

With the improved outfits now in use shade trees are sprayed the ground, so that climbing is not necessary and it is possi greatly increase the number of trees that can be treated in a sing day, and the machinery is so reliable that very little time is lo break downs. This has greatly decreased the cost of treatme tree.

In treating for the brown-tail moth it is usually desirable to off the hibernating webs of the insects and at the same time it

[illegible] to treat with creosote such gypsy moth egg clusters as can be [illegible]. Control work for the leopard moth is far more difficult and [illegible] appears evident that if the trees are kept in a vigorous condition, [illegible] injury from the European elm bark beetle must be reduced to a [illegible].

[illegible] cities and town surrounding Boston expend large sums of [illegible] each year to care for their shade trees. It is not uncommon [illegible] town to expend $1,000 or more annually for elm leaf beetle [illegible] in addition to the cost of controlling the gypsy moth and the [illegible]tail moth and for other shade tree work.

[illegible] of the most striking examples that can be found in the region [illegible] and which illustrate the interest that is manifested in [illegible] of this kind is in the treatment of the trees on historic Boston [illegible] and those in the city of Cambridge, which lies just across [illegible] Charles river.

On the Common are many large elms and maples, some of which [illegible] eighty to ninety feet into the air. Owing to the strong public [illegible] in favor of the preservation of these historic trees, special [illegible] has been taken from time to time to protect them from insect [illegible], but in spite of this, considerable damage has resulted, especially [illegible] last few years, from the attacks of the leopard moth.

In order to replenish the soil fertility so as to give the trees every [illegible] opportunity to survive, the earth has been removed to a [illegible] of from one to three feet, depending upon the quality which was [illegible]. The poor soil has been hauled away and rich loam, mixed [illegible] lime, bone meal, and manure substituted. Already thirteen [illegible] have been treated in this way and the complete project contem[illegible] similar treatment of thirty acres during the next few years at [illegible] expenditure of about $200,000.

In addition to this, an entomologist has been employed to look [illegible] the insect problem and Mr. J. W. Chapman has had charge of [illegible] work for a year or more. He has made a special study of the [illegible] moth and the European elm bark beetle and has recently [illegible] an excellent bulletin containing the results of his investiga[illegible].

The greatest problem in connection with the insect work has been [illegible] control the leopard moth and Mr. Chapman has succeeded in reduc[illegible] the injury to some extent, but the task involves much difficult [illegible] tedious work and its ultimate success is impossible to forecast [illegible] present time.

In Cambridge, which has been termed the city of elms, much injury [illegible] resulted from the work of the elm leaf beetle. For several years [illegible] trees have been defoliated by this insect, as a result of poor

spraying, or failure to apply the poison early enough in the season. The leopard moth is exceedingly abundant in this city and is causing enormous injury. Over 1,000 large street trees, chiefly elms, have been removed or marked for removal during the past two years. Many of these were injured to some extent by bad pavement and other conditions. Nevertheless, it is a fact that in the adjoining city of Somerville, where pavement conditions are very similar and the tree growth is similar enough to that in Cambridge to permit a reasonable comparison, only a few trees have died each year. The leopard moth is fully as bad in Somerville as in Cambridge, and evidence of its work can be noticed without making a careful examination. The large historic elms in the college yard at Harvard University are for the most part in a dying condition, due entirely to these causes, and although an heroic effort was made to save them during the winter of 1909 and 1910 by pruning them severely and fertilizing the ground beneath them, it is now evident that most of them will succumb, in fact, some have already been removed.

In the town of Arlington, which immediately adjoins Cambridge, the street trees are in excellent condition. They have been sprayed systematically and have suffered practically no injury from leaf eating insects. To be sure, the leopard moth is present, and just how much damage it is destined to do is difficult to predict. The conditions, however, are in striking contrast to those in Cambridge. In a part of Arlington, street trees are less subjected to injury from pavements and this may account in a very slight degree for the differences noted. After all has been said, however, the insect problem is the most important, for if these pests are controlled the trees will have a fair chance to thrive but if the contrary is the case, their opportunity is exceedingly limited.

This subject brings up the question of the value which may properly be placed upon a well developed shade tree. It is impossible to state this at all definitely, although everyone appreciates the fact that shade trees add to the value of city or country property. If we base the value of a shade tree upon the cost of the small tree and the expense of planting and caring for it until it becomes large enough to give a reasonable amount of shade, we find that the total value is far greater than would be supposed. Undoubtedly this is a very conservative way of determining the value of such trees, as it shows what would be the cost of replacing them, although in addition to this it would be necessary to wait from ten to twenty years or more in order to obtain the result. In several cases tried in court the value of city shade trees has been rated as high as $500 each and this amount has been collected.

Dead and dying Elm trees, Massachusetts avenue, Cambridge, Mass., injured by Elm Leaf Beetle, Leopard Moth and European Bark Beetle. Photo, Sept., 1911.

Trees on Massachusetts avenue, Arlington, Mass., same street as that shown on the previous plate. There is no foliage injury on account of good care. Photo Sept., 1913

B... ...ston a contract was recently awarded for planting shade trees ... side of one of the fashionable thoroughfares. In doing this ... was necessary to take up a portion of the brick walk, dig out ... holes, and when the trees were planted, to fill in these holes with ... hauled from the country. It was required that the trees ... be pruned and protected for two years, and all that might die ... that period were to be replaced. The contract price for this ... averaged about $50.00 per tree and as this amount was con... by the people who resided on the street, it indicates, in a ... the value which they place upon shade trees. Of course this is ... far greater amount than would ordinarily be expended for tree ...anting in cities, but it should be remembered that the planting of a ... shade tree is merely the beginning of an annual expenditure of ...oney, if the tree is to grow and become worthy of the name.

In Cambridge, where so many trees have died, it has cost on the ...erage about $20.00 per tree to remove them, and this figure was ... because the contract was such a large one. The amount ... will have to be expended for removals should have been sufficient ... protect the trees for at least ten years.

It seems evident that any city or town can well afford to expend a ...atively small amount of money each year to care for large and ...able shade trees and protect them from insect damage, for if this ... done their death and removal is certain. Future shade must ... from planting small trees under much less favorable conditions ... those which surrounded the trees that have been removed. They ... be cared for many years before any considerable amount of ... or shade will be derived and it will be necessary to expend as ..., if not more, money annually to protect them than would be the ... if the large trees were put in good condition and given adequate ...tion.

The care of existing shade trees, and their protection from insect ... is so necessary that it should appeal strongly to citizens in ... community who are interested in their home town or city. If ... shade trees are worth several hundred dollars apiece, their preser... should be a matter of prime importance and their care should ... placed in the hands of competent and experienced men. These ... should have the benefit of the advice of the State Entomologist ... assistants and in order that proper remedies may be used, that ... should be given sufficient funds to investigate the habits of ... tree insects about which little is known, except that they cause ... injury to trees and are difficult to control.

I... probable that few cities have had as difficult an insect prob-

lem as those in eastern Massachusetts and it should be a source of congratulation to such that most of the pests which I have mentioned have not yet made their appearance. It should be a warning, however, and the facts should be taken advantage of before these pests appear, for, if the city or town trees are well cared for, they will be in condition to resist some of their enemies, particularly bark beetles which usually attack the unhealthy trees. Furthermore, if the work is in proper hands, it will be comparatively easy to discover the presence of serious pests even when they occur in small numbers and by applying immediate treatment the trees can be preserved.

The whole problem is one which should be given careful thought and attention in each community. Local public sentiment, however, is absolutely necessary if progress along this line is to be made.

PRESIDENT F. L. WASHBURN: A discussion of these two papers by Mr. Herrick and Mr. Burgess is now in order.

P. J. PARROTT: I wish to express my appreciation of this paper and to say that it is gratifying to hear of these promising results in spraying because the elm leaf miner has been very prevalent in New York State. Recalling the experiments on the case bearers on larch I would like to say that in the spraying of apple orchards we believe we have obtained similar results with lime-sulphur wash on the common case bearers on apples.

GLENN W. HERRICK: Mr. President, just one further word. I want to say also that in an experiment to control a bud worm of the pecan, in the South, which lives over winter in hibernacula on the branches, close to the buds, I obtained similar results by spraying with lime-sulphur.

E. D. SANDERSON: Mr. President, I would like to ask what is the cost of one of those outfits, and about what is the cost per tree for the regular spraying?

A. F. BURGESS: The cost for an outfit, the original investment for a high power machine, is about a thousand dollars. Professor Herrick can tell you the cost of the other machine.

GLENN W. HERRICK: We paid $200 apiece.

E. D. SANDERSON: What does it cost you per tree?

A. F. BURGESS: These facts are very difficult to get at because the spraying is done by town gangs. Some are efficient,—some are not so,—but in the city of Newton, where they have about fifty miles of shade trees, they sprayed and cared for last year nearly 3,000 large trees. They used arsenate of lead at the rate of ten pounds to the hundred gallons, and it cost about fifty cents per tree for one spraying.

[illegible] etc.[1] The experience has been, in eastern Massachusetts, in spraying for the elm leaf beetle, that if the work is done as soon as there is foliage enough to hold the poison in good shape, and if the poison is used at the rate of ten pounds to the hundred gallons, one spraying is sufficient. That is the way the trees have been treated in Arlington, and no serious injury by beetles has resulted.

GLENN W. HERRICK: I should like to say that this was the first year the elm trees had been treated. They were in bad shape, and we tried to do a good job and went over them twice, with a little less than five pounds of arsenate of lead to fifty gallons of water.

H. T. FERNALD: Mr. President, I would be very glad to give a confirmation of the condition in which the trees of eastern Massachusetts are found at this time, if such were necessary, but Mr. Burgess has not overdrawn it in any way. I think, however, that there may be one point to add. In western Massachusetts, speaking particularly of the town of which I am a resident, we have neither the gypsy moth, the brown tail moth nor the elm bark beetle, and yet, within the last three or four years, we have lost perhaps fifty elm trees which were from two to three feet in diameter at the bottom. This seems to call for an additional factor besides those enumerated by Mr. Burgess. The trees have been very carefully examined by plant pathologists and entomologists, several of whom have been available for this examination, and the conclusion has been arrived at that the death of at least a part of the large elms through Massachusetts was due not to insects or to disease, but to a series of rather remarkable climatic conditions. Apparently, the winter conditions were such for a year or two that large numbers of the smaller rootlets of these trees, which had not suffered for many years, were absolutely destroyed, and the trees finally went through what might be termed, perhaps, "a lingering death." The elm leaf beetle was not a factor in particular, for, though present, the trees were thoroughly sprayed and well taken care of, but I think that the weather may have been one of the factors in eastern Massachusetts, masked or concealed by the evident additional work of the insects present.

Z. P. METCALF: Mr. Chairman, in Raleigh we had two magnificent

[1] Since returning from Washington, the writer has obtained considerable data on the cost of spraying shade trees with different kinds of outfits. This information shows that by using a high pressure machine and a solid stream city shade trees can be sprayed for about $.20 each. There are many factors which have to be considered in figuring the cost of spraying, and as space in this issue will not permit a statement of details, it is hoped that it will be possible to prepare a paper later on giving the information secured.

elms that died, and, to the best of my knowledge, in the last [illegible] years there has never been an elm leaf beetle on those trees.

PRESIDENT F. L. WASHBURN: This reminds me of a condition [illegible] Minnesota. We are losing many of our fine oak trees, which [illegible] died this last summer in enormous numbers. This death [illegible] to be due to a borer or borers and also to a fungus attack on th[illegible]. Normally, I think these trees would withstand these attacks, [illegible] year ago we had a drought, and up to this last fall the ground [illegible] foot below the surface downward was as dry as tinder, and I [illegible] that while the trees would normally resist the attack of these [illegible], which probably occur every year, this last year they were so weakened by unfavorable conditions that they succumbed in large numbers. We have reared the borers, I believe. Mr. Spooner, what did [illegible] Buprestids prove to be?

C. S. SPOONER: There were two species, the flat headed apple tree-borer and the destructive borer, *Agrilus bilineatus*.

PRESIDENT F. L. WASHBURN: Any further discussion on these two papers? If not we will go to the next paper, "The Gooseberry Gall Midge or Bud Deformer (*Rhopalomyia grossulariæ* Felt" [illegible] Mr. Houser, of Wooster, Ohio.

THE GOOSEBERRY GALL MIDGE OR BUD DEFORMER[1]

(*Rhopalomyia grossulariæ* Felt)

By J. S. HOUSER, *Ohio Agricultural Experiment Station, Wooster, O.*

The gooseberry gall maker is a new pest of gooseberries, having been described by Dr. E. P. Felt[2] from material sent him by the [illegible]. It is not known to occur anywhere except on one farm in the vicinity of Camp Chase, Ohio, and there its work is of a serious nature.

The plant is injured by the insect working during the larval stage in the terminal buds of spurs and branches, causing the bud to become abnormal both in size and structure. The bud scales increase greatly in numbers and size and, lying closely one upon another form a gall somewhat resembling in miniature the pine-cone willow galls so commonly encountered upon the tips of willow twigs.

The injured bud is incapable of producing normal leaves and the plant, striving to maintain itself, develops secondary buds within [illegible]

[1] Contribution from the Ohio Agric. Exp. Station, and the Department of [illegible] Entomology, Cornell University.

[2] Journal of Economic Entomology. Description, Vol. 4, No. 3, p. 347. Journal of Economic Entomology. Hosts and Galls of Amer. Gall Midges Vol. 4, No. 5, p. 468.

gro... the first and these in turn becoming infested, there is formed ...ly a large knot or cluster of galls. A typical cluster is illustrat... in figure 1. Occasionally the injured cluster succeeds in putting ...ble growths which usually take the form of undersized twigs. S... cluster, starting to develop, may be seen in figure 2. These growths appear at the end of the first or second season as illustrated ... figure 3. As a rule, however, this secondary, "witch-broom" like growth does not develop, and one finds the infested plant with numerous, large, rounded gall-clusters located on any part of it as shown by figure 4.

History of the Insect. The work of the gooseberry gall maker was discovered for the first time during the summer of 1906 on the farm of Mr. C. D. Smith, Camp Chase, Ohio. Since that time the writer has examined gooseberry bushes in various parts of the state whenever the opportunity afforded, and while a student in Cornell University he sent a number of letters to some of the more important small fruit growers of New York State, by way of inquiry concerning the insect but it has never been found anywhere other than at the place of the original discovery.

Mr. Smith has been a rather extensive grower of gooseberries, having had at one time about an acre devoted to this crop. At the time the trouble was discovered, however, a good many of the bushes were dead and there was scarcely half an acre remaining.

During the last five years, so many of the plants died that the plot was destroyed, with the exception of a few plants and these are in a bad way. While it is true that the old age of the bushes undoubtedly was responsible in part for the present condition of affairs, it cannot be denied that the gooseberry gall midge has played an important role in the proceedings—so important, in fact, that the writer considers it a serious pest when it becomes established in a planting.

The Adult Insect. A detailed description of the adult will not be given here as it may be had in the publication already cited. Briefly, however, it may be said that it has the general appearance of the typical Cecidomyiid, with its long, ungainly legs and generally delicate structural characters. The gross appearance as to color is reddish brown.

The adult is very frail and doubtless lives but a very short time, as the eggs are laid within a few hours after the insect emerges. It is not at all likely to be seen by the casual observer unless it so happens that he be about at the time of emergence, as the adults which the ... procured, were obtained only after practically every resource in the way of breeding devices had been exhausted. The main diffi-

culties seemed to lie in maintaining proper moisture conditio... a slight fluctuation towards humidity caused the developm... mold upon the pupa or larva, as the case might be, and if th... became too dry the insect within perished.

The body of the female, upon emergence, is very heavy an... gish. Those specimens which the writer has observed were ... able to fly, and this fact is a very important feature in conn... with the spread of the pest. The males were lighter, more acti... fly at will.

The Egg. The egg, as stated previously, is deposited within a ... hours after the adult leaves the gall. Females emerging during ... night were ovipositing freely the next morning.

In appearance the egg is very narrowly elliptical, light red in co... and is about .4 mm. in length. Those observed by the writer in ... open were deposited singly or in clusters in the new growth com... from the old galls, this being the only place where he was successf... observing them. A very careful search was made for eggs at ... bases of healthy leaves, with the hope of obtaining some light o... the manner in which the gall was formed.

The Larva. The newly hatched larva is shown in figure 1. T... full grown larva measures about 2 mm. in length. As one wo... expect of members of this family, the body is divided into fourt... segments, but differing from most Cecidomyiids the "breast bo... like organ cannot be detected. The median body segments are m... longer than those at either end, the head is small, somewhat triang... and is capable of being retracted within the body segments whe... larva is disturbed. There are nine pairs of spiracles. On the fi... thoracic segment, slightly caudad, and on each side of the head i... brown nodule or button which is about the size of the spiracles ... has much the appearance of them. That these organs are not spira... was proven beyond doubt by mounting a specimen directly in bals... thus showing the details of the tracheal system. No tracheæ exte... from these structures.

The color of the larva is slightly faded salmon, with the head ... brown. During the winter and early spring one finds them sing... encased within the protecting, enlarged bud. If the insect is dis... sected out at this time, it will be found in the curled up position as... sumed by the larvæ of Lachnosterna sp. when disturbed, with the head against the base of its cell, apparently in a feeding pos... Immediately surrounding the body of the larva are green, living ... scales, usually of three scales thickness and surrounding thes... is ... wall of dead bud scales six or seven scales in thickness. Th...

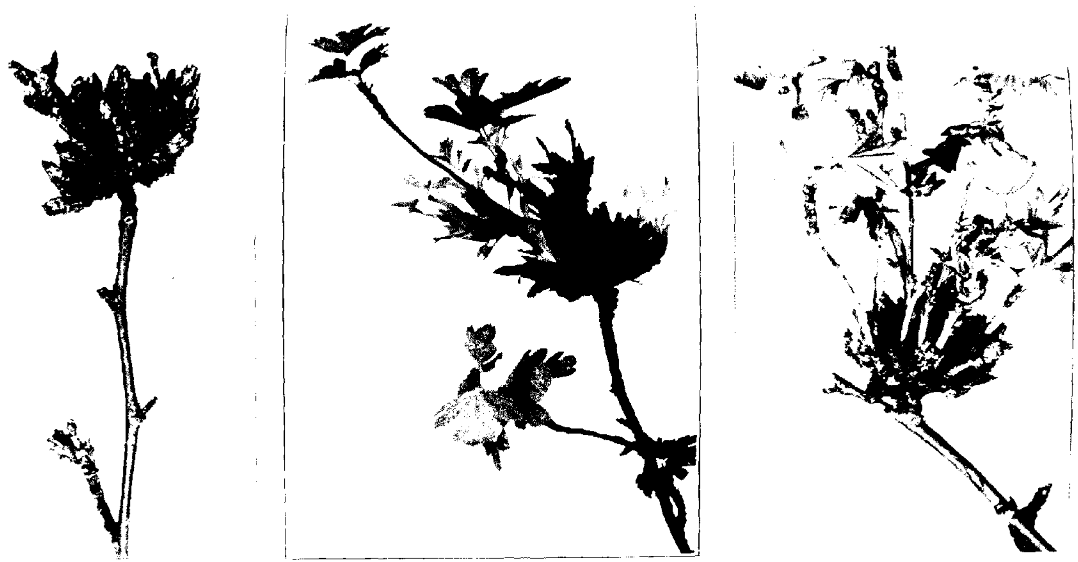
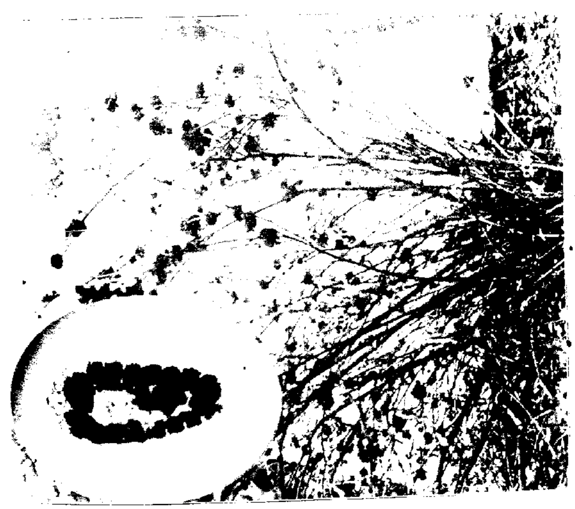


Fig. 1. A typical cluster of galls, natural size. • Fig. 2. A gall cluster throwing out a new, abnormal growth in spring • Fig. 3. A [illegible] broom growth which sometimes develops from [illegible] [illegible].



scales are drawn closely together at the tip, particularly the green inner ones, thus making a secure home for the larva. So perfectly in fact do these scales fit one upon another that the cell within will remain moist for a few hours, even though the surrounding atmosphere is very dry.

The Pupa. Pupation occurs in the cell occupied by the larva. The larva reverses the position of its body before transforming so that the pupa rests with the tip of the abdomen next the base of the cell. A pupa within the pupal cell, one side of which is torn away, may be seen in figure 5. The male pupa is a little less than 2 mm. in length; head, thorax and appendages a dirty black, and the antennæ extend three-fifths of the distance to the tips of the wing pads. The encased legs reach to within two to five segments of the tip of the body. The abdomen is at first tinged with pink, later becoming a very dark pink. On the dorsal side of the thoracic segments is a lighter median line.

The female pupa is slightly longer, with comparatively shorter appendages and with a much enlarged abdomen.

Life History and Habits. The life cycle and habits of this insect are not perfectly understood, but enough is known to permit suggestions for remedial measures to be made with assurance.

The adults appear during the early part of May, the first ones observed this season having emerged the ninth or tenth. Within a few hours after emergence the eggs are deposited and these hatch, apparently, within a few days. How the gall is formed is not known. Neither is it known whether the larval stage extends over more than one season. The only data which the writer has to present upon this point, is that at mid-summer there may be found galls which are apparently fully developed and which contain in the normal position a larva which seems about one-tenth grown. He has not succeeded in finding large larvæ during mid-summer, nor has he found anything except pupæ or adults at the season of the appearance of the full grown insect; so the natural assumption is that the larval stage does not extend over more than one season.

The larvæ transform to the pupal stage about April 1. At this time the live portion of the injured buds develop slightly and the green inner scales begin to push out beyond the dry ones. As growth continues, these green portions apparently carry the pupa along with them and by the time the adult is ready to emerge, the pupa has been pushed at least partially out of the gall proper. When the insect transforms, the dirty-gray, delicate, pupal skin is left hanging at the tip of the old gall.

The Insect's Future as a Pest. The insect has been a serious pest on Mr. Smith's farm, and it is the belief of the writer that prompt measures should be taken against it as soon as its work is observed. As stated previously, the female is very sluggish in her movements, apparently being scarcely, if at all, able to fly. This, taken in consideration with the fact that gooseberries are rarely grown on a very extensive scale and usually are found in isolated patches, indicates that there is little likelihood of the pest becoming generally distributed.

Natural Enemies. No parasites have been observed working upon the insect, but several dead larvæ have been observed, apparently killed by some bacterial disease.

Remedies. The remedy is so obvious, now that we know something of the life history, that it seems scarcely necessary to state it, namely: cutting out and burning the gall clusters during the fall or winter. The work in order to be effective must be done with care and thoroughness, for quite frequently isolated galls occur which are difficult to find, and these by escaping destruction would be sufficient to perpetuate the species.

PRESIDENT F. L. WASHBURN: Any discussion upon this paper? If not we will pass to the next paper on the programme, "Occurrence of Pear Thrips in New York," by Mr. Parrott.

THE OCCURRENCE OF THE PEAR THRIPS IN NEW YORK

By P. J. PARROTT

This species, *Euthrips pyri* Daniel, has attracted much attention in recent years because of the course which it has run in California. Its importance to the deciduous fruits of that state, and the efforts that have been made to establish more efficient methods of control are well known. Peculiar interest is now centered in the thrips because of its presence in a region very remote from its heretofore recognized area of distribution, where it is playing a like role as a destructive fruit pest. It is the purpose of this paper to present some observations upon its distribution and work in orchards in New York.

Distribution in the State. The pear thrips was discovered first at Germantown in the Hudson River valley where it was very destructive in many orchards in the immediate vicinity. The pest

[1] Moulton Dudley, Circular, Cal. State Com. of Hort.; Bul. 68, pt. I and 80, Pt. IV, U. S. Bureau of Entomology.

Foster, S. W. and Jones, P. R., Circular 131, U. S. Bureau of Entomology.

...ly injurious in plantings about the neighboring communities of N... Germantown and Cheviot. Scattering numbers of the insect w... seen on pear trees grown south of this region, about Tivoli; to th... north about Stuyvesant, and eastward to a line running between C... ham and Clermont. According to Mr. C. E. Hover, an extensive fruitgrower at Germantown, the thrips has caused most damage in a compass of about ten miles of this village, although it has not been equally destructive in all orchards. It is probable that the insect occurs over a larger area than is indicated by these bounds. Several growers, who reside across the Hudson River and have recently had their attention called to the destructiveness of the thrips, have expressed their opinions that the work of this insect was also observed during the past spring in their plantings about Milton and Marlboro. It is expected that the distribution of the pest in this State will be determined within closer limits during the coming year.

The area in which the pest occurs is located in the leading fruit-growing section of the Hudson River Valley. It is a hilly region, but the slopes are admirably adapted to the growing of the common bush and tree fruits, which are cultivated in an intensive manner. The individual holdings are as a rule small, but they are thickly planted; and as seems to be the prevailing practice each farm usually has a pear orchard as well as plantings of other fruits.

Nature of Injuries and Conditions in Orchards. The adult thrips were very abundant on all of the common tree fruits grown about Germantown, such as the apricot, apple, sour and sweet cherry, peach, pear, plum and quince. Pears generally sustained the greatest damage although the insect seemed to be equally numerous on other fruits, especially the sweet cherry and the apple. Of the leading sorts of pears grown in this community, Kieffer suffered the most and there was not an orchard of this variety among a large number examined by the writer that did not show evidences of the work of the thrips. Orchards on warm and protected slopes seemed to be especially attractive to the insects, which was attributed to the advanced condition of the buds. During the latter part of April and early May the thrips swarmed about the trees, injuring the buds and blossom clusters, which turned brownish or blackish and appeared as if blasted. The ... which were most severely attacked were wet with sap which ... down the fruit spurs, moistening the bark of the large branches. ... bud scales, leaf stipules, blossom bracts, sepals of unopened ...soms and margins of leaves were blackish or discolored. In some ...ards such a large percentage of blossoms were destroyed that ... little fruit was harvested. While such damage according to ... statements of fruitgrowers, has been more common in preceding

years, it was the exception during this spring. Seckels suffered almost as severely as Kieffers, while Bartletts and Clapp Favorites, though showing considerable blighting of blossom clusters in different plantings, were not in the main seriously affected.

In view of the importance of the attacks of the thrips on sweet cherries, the conditions in plantings of this fruit were carefully noted. Such varieties as Black Tartarian, Napoleon Bigarreau, Schmidt's Bigarreau and Windsor are the leading commercial sorts, and these were frequented by large numbers of the thrips from the time of the spreading of the winter bud scales to the dropping of the blossoms. As has been commented on by other writers, the most noticeable work of the pest was on the fruit stems which were much scarred as a result of oviposition. From the appearance and the numbers of the worms it was at first thought that there would be considerable early falling of fruit. Premature dropping of cherries occurred to a slight degree, but in spite of the numbers of the thrips the trees produced satisfactory yields; and the fruit, because of favorable weather conditions, was of superior quality. There is much interest on the part of fruit growers as to the probable effects of oviposition upon the cherry crop because during some seasons there is considerable yellowing of the stems which is sometimes attended with premature dropping of much of the fruit. The larvae were observed in large numbers under the "husks" or loose calyces of the fruits; and, while an occasional cherry showed abrasions of the skin, the value of the crop was not appreciably affected. The leaves of sweet cherry trees were attacked by both adults and larvae, and as a result of their injurious work the foliage was generally full of holes and sometimes quite ragged in appearance. Apples, apricots, sour cherries, peaches, plums, and quinces, in spite of the numbers of the insect, showed as a rule only slight evidences of injury.

History of Thrips about Germantown. The writer interviewed many growers upon the early history of the thrips in order to account for its presence in a region so distant from its well-known habitat. However, very little definite data was obtained as in the past the injuries to the trees have been attributed to spraying mixtures and late frosts, and the insect was not recognized as the originating cause of the unfavorable conditions of the trees until this year. From the statements of orchardists it seems that the thrips has been at work in some plantings for at least five years and recently its ravages have become increasingly conspicuous until 1910, when it was generally exceedingly destructive. During that year the yields of Kieffers were much reduced and the losses were large because of the extensive orchards of this variety. The opinion generally prevails that the introduction of the thrips in this region is of recent origin and the

...ally increasing in destructiveness. Future observations may ... this conclusion. Prolonged droughts for successive years and ...normally early development of fruit buds during 1910 afforded ...s exceptional conditions for its destructive work that year, ... eventually led to its detection. The question may well be ... as to whether the insect has been lately introduced or is a well-...ished species which has recently emerged from a state of obscurity ... has risen at last to a position of first prominence.

...trol of Thrips by Spraying. The Station conducted a number of ex...riments with various spraying mixtures, largely according to the ...gestions of Foster and Jones, which have recently given such prom-...ing results in their work in California. The standard nicotine prep-...ations with either soap or kerosene emulsion proved exceedingly ...sfactory sprays, for they killed all the insects wetted by them. To destroy the thrips buried in the substance of the bud or in the compact blossom clusters the use of the oil emulsion with the tobacco extract is perhaps to be preferred; but when the thrips are in exposed positions a combination of the nicotine spray with soap was surprisingly effective. Both of the above combinations proved to be very safe to the foliage and, notwithstanding the fact that the trees were sprayed from three to four times on successive days, there was no material injury to the leaves. As recommended by the above writers, the Station will advise the growers of this State to make at least two appli-...tions for the adults to protect the expanding buds and blossom clusters, and one or two treatments to destroy the larvae. In the spraying of pear orchards the young thrips were very susceptible to treatment. The accumulative effects from a systematic spraying of the trees each year must be considerable, and the applications to kill the larvae appear to be a very important consideration in the spraying schedule.

Injuries to Pears by Other Species. Two other species of thrips which may be observed on fruit trees in New York are *Euthrips tritici* Fitch and *Thrips tabaci* Lind. During some seasons both species are ... common, but the former appears to be usually more numerous than the latter. Ordinarily they do not seem to cause any appreciable damage to fruit trees, and only once in the writer's experience have they proven very destructive in orchards. This outbreak occurred during the spring of 1909 and marked damage was done in pear orchards in western New York, principally about Ransomville, Burt and Mid-...port. The varieties sustaining the greatest losses to the blossoms ... Bartlett, Kieffer and Dutchess. The effects of the work of ... thrips were not unlike those of *pyri*, except that the damage was not so extensive. The injured blossom clusters similarly turned

brown as if blighted, while the leaves became discolored abou. the wounded areas and curled. Microscopic mounts indicated the *tritici* was more abundant on the trees than *tabaci*. For the identification of the species, I am indebted to Dr. W. E. Hinds of the Alabama Polytechnic Institute.

PRESIDENT F. L. WASHBURN: Any discussion on this paper?

GLENN W. HERRICK: I should like to ask Mr. Parrott whether he used the Black Leaf 40 or simple Black Leaf?

P. J. PARROTT: We used both preparations and we used them alone, with soap and with kerosene emuslion.

GLENN W. HERRICK: At the usual strengths?

P. J. PARROTT: The mixtures were somewhat stronger than recommended by Foster and Jones, because we had not received their publication at that time. Black Leaf extract was applied at the rate of a gallon to sixty-five gallons of water and with five pounds of soap, while the Black Leaf 40 was used at the rate of $\frac{3}{4}$ of a pint to a hundred gallons of water with the same amount of soap. Nearly all the fruit growers have power spraying outfits, and there is no reason why most of them cannot spray their orchards in a day, so that there certainly will not be the difficulty in thoroughly spraying the trees as obtains in California because of their extensive plantings.

E. D. SANDERSON: I would like to inquire how the insects hibernate.

P. J. PARROTT: I think that some of the members of the staff of the Bureau of Entomology are much better prepared to answer that question, but in New York the adult thrips are now in the ground. We obtained the first specimen November 29th.

PRESIDENT F. L. WASHBURN: Any other remarks on this paper? The next paper on our programme is by Mr. Hunter of Texas. "Some Experiments to determine the Effects of Roentgen Rays on Insects."

RESULTS OF EXPERIMENTS TO DETERMINE THE EFFECT OF ROENTGEN RAYS UPON INSECTS

By W. D. HUNTER, *Bureau of Entomology*

The whole science of radiology is of such recent development that it is not surprising that but very few experiments have been performed upon insects. In fact, a somewhat careful search through the literature has revealed but two accounts of experiments that have been performed. One of these experiments was performed by Forel and Dufour. It was with the European ant, *Formica sanguinea*. The primary object of the experiment was to test the susceptibility of

this ant to the ultra-violet rays. Apparently, as an afterthought, it was arranged to subject the insects to Roentgen rays. The apparatus used was a box about the size of a cigar box in which the ant colonies were placed. The apparatus was placed above the Roentgen ray apparatus. Sliding lead plates on the bottom of the box allowed the operators to direct the rays into different parts. When the ants were collected in one corner, for instance, the rays were admitted from directly beneath them. The results were absolutely negative. The ants showed no tendency towards being affected and continued their work in the normal manner. This was considered somewhat remarkable by Professor Forel since it followed experiments which had showed that the ants were quite sensitive to the ultra-violet rays. As far as the Roentgen rays were concerned it was concluded that they were not perceived by the ants. Neither was there any after-effect upon the ants; they appeared entirely normal for a period of eight days after the experiment, at which time the observations were discontinued.

The only other experiments of which we have been able to find any record are dealt with in a paper by Professor Axenfelt in the Centralblatt für Physiologie, 1897. In these experiments house flies were used. The insects were placed in an apparatus consisting of two chambers with a connecting passage. One of the chambers was constructed of lead and the other of wood. Both could be completely darkened at will. When the flies were in the leaden chamber, which, of course, was not penetrated by the rays, an exposure of four or five minutes caused them to pass over to the other chamber. When they were placed in the wooden chamber and exposed to the rays they remained there even when that chamber was darkened and the other light. The investigator concluded that the experiments showed that the house fly can perceive Roentgen rays and that they affect it in much the same way as ordinary light. The account of the experiments which was published is not detailed and it seems that the conclusions the author reached are hardly above criticism. There is a possibility that a difference in temperature in the two chambers due to the construction of different materials may have caused the movement of the insects from one to the other. This supposition appears to be more plausible in view of the experiments of Forel and Dufour which were performed under the most careful conditions of control.

One of the many remarkable features of Roentgen rays is their effect upon the sexual organs of certain animals including man. Until it was discovered, some ten years ago, that the rays had a very remarkable effect upon the organs of regeneration even when no external lesions whatever are caused, many operators were completely ster-

ilized without any knowledge of the fact. This matter has been investigated carefully by a number of students in France and Germany. In fact, the histology of the organs subjected to the rays has been determined with great care. It has been found that certain kinds of cells are remarkably susceptible to the rays and that their functionality is entirely destroyed although morphologically they seem to be almost normal.

During the past year by accident the writer and several of his associates have had an opportunity to conduct a number of experiments with Roentgen rays. In these experiments special attention has been directed toward the determination of the question of whether the sexual organs of insects are affected in any manner analogous to that in the case of human beings, guinea pigs, rabbits and other animals with which the experiments noted were performed. At Dallas, Texas in April, 1911 the experiments were begun with *Calandra oryzae*, several species of ticks, and two Isopods, *Armadillidium vulgare* and *Porcellio laevis*. The manipulation in the experiments with the rice weevil are typical of the procedure that was followed in all cases. Grain containing large numbers of adults and immature stages was exposed to the rays at different distances and different periods. The exposure averages from ten to twenty seconds, the distance from the tube from fourteen to twenty inches and the current from five to seven milliamperes. After exposures according to the plan large numbers of the adult beetles were taken from the cages and placed in jars with grain which had been thoroughly sterilized by means of heat. It was considered that observations as to whether reproduction took place in this sterilized medium would show whether any effect had been produced upon the reproductive organs of the insect.

In brief the experiments are negative. In all but two of the test experiments reproduction took place. It varied, of course, greatly in the different jars but this variation did not seem to be correlated with any differences in the treatment. In fact, the two series in which no reproduction was found to take place represented the longest exposure and the shortest.

The next experiments were performed with ticks of various species. The first series was designed to determine the effect of the rays upon eggs of *Margaropus annulatus* which were on the point of hatching. Such eggs were exposed from 1 to 15 seconds at a distance of from 11 to 18 inches, with a current of 5 to 7 milliamperes. In the exposed lots from 10 to 70 per cent of the eggs hatched, in one of the controls 30 per cent, and in the other 50. It was not evident, therefore, that the rays had any effect whatever upon the eggs. Another experiment

with eggs of *Margaropus annulatus* in which incubation had begun. These eggs began hatching from 20 to 25 days after exposure. Eventually from 75 to 90 per cent hatched. There was a hatching of 80 per cent in the controls. This experiment therefore corroborates the conclusion from the prior experiment regarding the harmlessness of the rays to the eggs.

Later series of experiments were performed with the female ticks which were depositing eggs, with females which were engorged but which had not begun the deposition of eggs, and with unengorged larvae. The variation in the length of the exposure and other details were similar to those in the experiments that have been described. In all of these cases no effects from the rays were discernible.

In further experiments other species of ticks were utilized including *Argas miniatus* and *Dermacentor venustus*. In no case was any definite indication obtained of any effects whatever from the rays.

Somewhat later experiments were conducted at New Orleans with the sugar cane mealy bug, *Pseudococcus calceolariæ*. In this work a new factor was added. This was the determination of whether the effects of the rays tend to accumulate. It seems to be well established that in the case of human beings the effects accumulate in regular progression, that is that an exposure of one second on ten different days has exactly the same effect as an exposure of ten seconds in one day. In the case of the sugar cane mealy bug, gravid females were exposed for 1, 2, 4, and 8 minutes and also for 1 minute on 1, 2, 3, 4, 5, 6, 7 and 8 days. All exposures were at a penetration of 5, according to the Benoist radio-chronometer. In these experiments the time elapsing from exposure to hatching varied without any apparent connection with the number of days exposed. The control females yielded eggs which hatched in 3 days and this was the case with eggs from 1, 2, 5, 7 and 8 day exposures.

Similar experiments with the eggs of *Culex pipiens* were performed. The accumulated exposures did not yield any more definite results than in the case of the other species.

Up to this point our experiments (except those with the rice weevil) were concerned primarily with the determination of the possible destructive effect upon the insects in various stages and especially upon the viability of the eggs. A series of observations was made, however, more particularly to determine the effect upon the functionality of the sexual organs. In these experiments several species including the boll weevil, were tried but the most satisfactory results were obtained with the sugar cane borer, *Diatræa saccharalis*. In this case all of the specimens utilized were bred to maturity under isolation to obviate the possibility of accidental fertilization. Exposed

males were later placed with unexposed females; in another series exposed females were placed with unexposed males; and in the third both sexes were exposed to the rays. The exposure varied from 1 to 16 minutes in the different experiments.

In a few of the cases no eggs were deposited but such occurrences were explainable by factors which had nothing whatever to do with the Roentgen rays.

In the case of the exposed males placed with unexposed females, even when the exposure ran as high as 16 minutes, eggs were deposited in normal numbers and were found to be viable. In fact, the larvae were bred to maturity. Exactly the same is true of all of the experiments in the series in which the exposed females were placed with unexposed males. In the third series, however, in which both sexes were subjected to the rays for the varying periods no fertile eggs were deposited. In this case the control failed to produce eggs so that no conclusions can be drawn.

The foregoing gives but a meager outline of the numerous experiments that were performed. The results are possibly open to criticism on account of the methods of manipulation that were followed. There is so much difference in the effects of the rays upon human beings depending upon the penetration, the length of the exposure, the amperage and voltage, that it is conceivable that under some conditions insects may be affected. Nevertheless, in all of the work we have done it is not apparent that the rays have had any effect whatever upon the fertility or the development of the various stages of the several species utilized in the experiments. At any rate the rather considerable amount of work done has not shown that there are any indications of any practical utilization of X-rays in the destruction of injurious species.

President F. L. Washburn: Any question to ask Mr. Hunter?

T. J. Headlee: Mr. President, have they gone far enough to determine whether the rays of light in any way affect the transmission of characters?

W. D. Hunter: In no way at all.

E. W. Berger: Mr. Chairman, I have recently conversed with a man in Florida who is interested in the big business affairs of that State, and he told me that they were planning to sterilize the eggs of the tobacco beetle in Cuba by means of the X-rays. He told me that he was interested in the subject and was working on it at that time. He seemed to have no doubt at all that the thing would be successful. It was altogether new to me, and, of course, Doctor Hunter's results here are all contradictory to this man's results

W. D. HUNTER: I think that the present plan of control of insects in tobacco does not concern itself with X-rays at all, but with a high frequency current. The man referred to carried on numerous experiments in Philadelphia, first with X-rays but later with high frequency currents. One of my associates provided numerous tests with the X-ray apparatus. It was found that the results were not satisfactory. At that time the experiments turned to high frequency currents.

PRESIDENT F. L. WASHBURN: The next paper on the programme is by Mr. Swenk, of Nebraska, on "The More Important Injurious Insects in 1911 in Nebraska."

THE MORE IMPORTANT INSECTS IN 1911 IN NEBRASKA

By MYRON H. SWENK, *Lincoln, Nebr.*

(*Paper not received*)

The following papers were read by title and made a part of the proceedings:

THE SUSCEPTIBILITY OF ADULTS AND EGGS OF PEAR PSYLLA TO SPRAYING MIXTURES

By P. J. PARROTT AND H. E. HODGKISS

(*Abstract*)

In summarizing briefly this paper the chief points presented are, (1), that the emergence of adults from winter quarters, deposition of eggs and migration of larvæ occur with very little intermingling at distinct time periods and are, to a large degree, coincident respectively with certain life events of the pear tree, as the swelling of the buds, development of the blossom clusters, and opening of blossoms; (2), that the psylla in each of its life stages is sensitive to certain spraying mixtures. Experiments in 1910 indicated the possiblitity of protecting pear orchards by a single treatment to kill either the adults, or eggs, or nymphs.

The presence of the psylla in destructive numbers in 1911 in the leading pear growing sections of western New York afforded exceptional opportunities for a large series of tests to demonstrate, under ordinary orchard conditions, the susceptibility of hibernating "flies," eggs and nymphs to various mixtures. Quite a number of growers freed their orchards of the pest by spraying for the "flies" with miscible oils, home-made emulsions or commercial nicotine preparations. The

majority of orchardists, after spraying for the "flies," applied lime-sulphur solution at winter strength to destroy the eggs. In only a few plantings was it necessary to make a third treatment with a nicotine spray to kill the young nymphs.

In summing up the results of the spraying operations it was concluded that the chief factors which make for the successful control of the psylla are (1) a knowledge on the part of the grower of the different stages of the insect: viz., hibernating "flies," eggs and nymphs, (2) an understanding of the activities of the psylla during the dormant season until trees blossom; and (3), thorough work in spraying.

PROGRESS IN EXTERMINATING TWO ISOLATED GYPSY MOTH COLONIES IN CONNECTICUT

By W. E. Britton, *Agricultural Experiment Station, New Haven, Conn.*

In March, 1906, it was learned that the gypsy moth, *Porthetria dispar* Linn., was present in Connecticut at Stonington, the southeast corner town of the state. An immediate investigation showed the infestation to be a separate one of less than a square mile in area, and about fifty miles from Providence, R. I., the nearest point known to be infested. Measures were at once started with a view to complete extermination rather than mere suppression, as must be practiced in the large and badly infested sections of Massachusetts and New Hampshire.

In December, 1909, another isolated infestation was discovered in the village of Wallingford, twelve miles north of New Haven. Here the infested territory was probably no larger than that at Stonington, but was much more thickly infested and less scattered.

The exterminative work has not been done wholly by the state of Connecticut. The Bureau of Entomology has a special appropriation for gypsy moth work, and a portion of it under the supervision of Mr. D. M. Rogers, has been used to aid and supplement the work of the state.

We are now able to consider the progress made in six years at Stonington and in two years at Wallingford. The object of this paper is to show the results of this work in figures, so far as may be possible.

The methods employed were those in common practice in Massachusetts and other infested states. Scouting for egg-masses during the winter months when the trees are bare, destroying the eggs with creosote; pruning, scraping and filling the cavities of trees; banding trees in summer with burlap and in some cases with tree tanglefoot; spraying trees and shrubs with lead arsenate. In scouting for egg-

[illegible] there were a number of cases where stone walls had to be torn down and relaid and several cases where they had to be burned out with a torch to kill caterpillars. Many acres of brush land had to be cut and burned over at Stonington. Rubbish heaps and fences were overhauled. Young men were employed to turn the burlap bands each day or every other day from about the middle of May to perhaps the middle of July. Each man was given a certain territory and made responsible for the caterpillar conditions in it. He was given a pair of forceps and a four ounce bottle containing denatured alcohol, gasolene, or kerosene, and required to bring to headquarters each noon and night all caterpillars that he could find. The superintendent kept a record of each man's collections, and spent most of his own time watching the work of the men and scouting for caterpillars.

STONINGTON

Year	Egg-masses destroyed	Caterpillars destroyed	Pupae destroyed
[illegible]	73	10,000	47
[illegible]	118	2,030	200
[illegible]	76	2,560	44
[illegible]	6	98	0
[illegible]	1	146	0
[illegible]	3	0	0

WALLINGFORD

Year	Egg-masses destroyed	Caterpillars destroyed	Pupae destroyed
[illegible]	8,234	8,936	95
[illegible]	23	1,551	15

COST OF GYPSY MOTH WORK

Year	State funds	Federal funds	Total per year
[illegible]	$1,500.00	....	$1,500.00
[illegible]	4,550.00	$272.00	4,822.00
[illegible]	2,550.00	77.00	2,627.00
[illegible]	1,503.22	42.00	1,545.22
[illegible]	4,560.22	1,411.36	5,971.58
[illegible]	4,017.95	4,660.22	8,678.17
Total	$18,681.39	$6,462.58	$25,143.97

The accompanying figures were obtained in this way, and do not include the hundreds and probably thousands of caterpillars which we know were killed at Wallingford by the lead arsenate and the tanglefoot bands; neither do they include those killed by fire on the walls at Stonington, but are simply a record of the insects found and destroyed by the men working day after day.

It should also be stated that the money expended in this work in the state ($18,681.39) includes the cost of much scouting outside the infested regions, following up reports of infestations, and the traveling expenses for most of the work of inspecting imported nursery stock for the last three years. It also includes the cost of scouting and destroying brown-tail nests in five towns in the northeast corner of the state last winter, so that the actual amount expended in gypsy moth extermination would be considerably less. The Federal money has practically all been used for scouting, both in and outside of the infested territory.

(*Proceedings to be continued.*)

UNCONSIDERED FACTORS IN DISEASE TRANSMISSION BY BLOOD-SUCKING INSECTS

By Frederick Knab, *Bureau of Entomology, Washington, D. C.*

The study of the rôle of blood-sucking insects in the transmission of disease is a recent one, and it is still to a large extent vague and chaotic. Its teachings are not only built up largely on hastily collected and faulty data, but they are replete with errors. Many of the investigators not only have lacked the necessary knowledge of biology, but the mastery of detail, along with a broader view, which is eminently necessary in such work. Since the discovery that certain blood-sucking insects are the secondary hosts of pathogenic parasites, nearly every insect that sucks blood, whether habitually or occasionally, has been suspected or considered a possible transmitter of disease. No thought seems to have been given to the conditions and the characteristics of the individual species of blood-sucking insects, which make disease transmission possible.

In order to be a potential transmitter of human blood-parasites an insect must be closely associated with man and normally have opportunity to suck his blood repeatedly. It is not sufficient that occasional specimens bite man, as, for example, is the case with forest mosquitoes. Although a person may be bitten by a large number of such mosquitoes, the chances that any of these mosquitoes survive to develop the parasites in question (assuming such development to be possible) and then find opportunity to bite and infect another person are altogether too remote. Applying this criterion

not only the majority of mosquitoes, but many other blood-sucking insects, such as Tabanidæ and Simuliidæ, may be confidently eliminated. Moreover these insects are mostly in evidence only during a brief season, so that we have the additional difficulty of a very long interval during which there could be no propagation of the disease in question.

The truth is that all insects that have been found to be transmitters of human blood-disease are more or less closely associated with man and habitually suck his blood. This relation has long been recognized in the case of the two house-mosquitoes of the tropics, the one (*Aedes calopus*) being the intermediary host of the yellow fever organism, the other (*Culex quinquefasciatus*) of those of filariasis and dengue fever, but its significance has not been grasped. It is only through a combination of circumstances that these insects are effective transmitters. These conditions are: The association with man and a predilection for his blood, abundance, comparative longevity which means blood meals repeated at intervals, and practically continuous breeding, so that individuals are always present to act as intermediary hosts of the parasites. When these conditions are fulfilled the chain in the life-cycle of the parasite is continuous and we have an endemic disease. The relations just outlined might be expressed in terms of mathematical formulæ, but nothing would be gained thereby. It is the recognition of the principles involved that is important.

The writer is not at present in a position to review the entire field of disease transmission by biting insects from this viewpoint. However one more striking example in support of his views may be cited. This is the large hemipter *Triatoma (Conorhinus) megistus* which Carlos Chagas recently has shown to be the transmitter of a dangerous trypanosome disease of man in Brazil. As I have already pointed out in another place (Proc. Ent. Soc. Wash., xiii, 71, 1911) *Triatoma megistus* is remarkable among the American members of the genus in showing close adaptation to man. It lives in houses and does not occur naturally apart from man. The eggs are laid in the crevices of walls inside of houses and the young bugs feed on human blood from the start. In spite of its very large size, the bite of the adult occasions so little pain that it does not awaken a sound sleeper. This is clearly adaptational, as the wild species of the genus are known to have a very painful bite. Still another example are the biting flies of the genus *Phlebotomus*, which, in the Mediterranean region transmit the so-called pappataci fever. Here too the species involved are closely associated with man.

It would seem at first thought that *Anopheles*, in the transmission of malaria, does not fulfill the conditions above formulated. The

species of *Anopheles* have not been looked upon as particularly associated with man. However this is only due to the fact that the habits of the *Anopheles* have not been properly understood and particularly to the failure to differentiate the habits of the different species. There is every indication that those species which transmit malaria thrive in the vicinity of man, while, on the other hand, those species which live apart from man and do not habitually seek his blood are inoffensive. That the habits of the different species of *Anopheles* differ widely and are in direct relation to their effectiveness as transmitters of malaria is brought out in an interesting manner in the paper by Mr. Jennings on mosquito control in the Panama Canal Zone (printed on the preceding pages of this number). Conversation with him has added further data that support this view. Investigation of the role of the different species in the transmission of malaria, by inducing them to bite malaria carriers, has shown that *Anopheles albimanus*, the species which thrives particularly about settlements and is most persistent in entering houses and obtaining blood, is the principal factor in malaria transmission—no less than 70 per cent of this species developing the parasites.[1] An interesting point, brought out in conversation with Mr. Jennings, is that this species appears to be absent from those parts of the upper Chagres River which are uninhabited. It is highly probable that the reason for the absence of *Anopheles albimanus* from such localities is that this mosquito not only prefers, but probably needs, human blood. It has been suggested that the absence of *albimanus* from the upper Chagres was due wholly to the absence of suitable breeding-places. It appears, however, that this objection is not valid. Both Mr. Jennings and Mr. Busck have explored the Chagres for mosquitoes and they assure me that there are abundant opportunities for *A. albimanus* to breed. Neither of them found *albimanus* and they could hardly have failed to do so had it been present.[2]

The observations of James and Liston on the habits of the *Anopheles* of India show that the species of that country likewise differ in habits.

[1] Darling, Samuel T., Studies in relation to malaria. Washington, Govt. Printing Office, 1910.

[2] Since writing the above I have come upon a record of observations on *Anopheles tarsimaculata*, a geographic race of *albimanus*, by the Rev. James Aiken of [illegible] British Guiana, which support my contention. Under the name *Cellia* [illegible] indicates the relation of this species to man as follows: "It is to be noted that at the Canje creek further up than Baracara I found no Anophelina, the same [illegible] applies to the Berbice River above Mara, and in a collection made by Mr. [illegible] at Sandhills none appeared. On a visit to the Supenaam creek I was also unsuccessful in finding this mosquito. All these districts are very sparsely populated and so far as our observations go they are only to be found near human dwellings."—(British Guiana Medical Annual for 1906, Demerara, 1907, p. 66.)

and they speak of "domestic" and "wild" species.[3] However the significance of the phenomenon seems to have escaped them, as it has subsequent investigators. There is no doubt in the writer's mind that a critical review of the data will show that the *Anopheles* responsible for the transmission of malaria in India will be found among the "domestic" species, as the term is applied by the above mentioned authors.

There is a paper by Dr. Adolph Lutz of Brazil, on forest mosquitoes and forest malaria, which apparently contradicts the ideas just expressed with reference to *Anopheles* and malaria.[4] The probabilities are, however, that Doctor Lutz has misinterpreted the facts. His observations were made in the state of São Paulo, during the construction of a railroad from the coast to the capital. The first part of the route was through the moist and heavily forested slope from the table-land to the coast, and while at work here a large part of the construction gang were afflicted with malaria. Lutz searched for the transmitting *Anopheles* but could find no breeding-places upon the steep slopes. Finally he determined that only one species of *Anopheles* (*cruzi*) was present in the region, and that this bred abundantly in the water held by epiphytic bromeliads. To this species he attributed the outbreak of malaria. Most probably this *Anopheles* had nothing to do with the outbreak of malaria among the laborers. It is a well-known fact that in the tropics most persons, although apparently in good health, have latent malaria. When such an individual comes under some physical strain, such as overexertion, exposure, or some form of overindulgence, the disease manifests itself. It seems highly probable that this is the explanation of the outbreak observed by Doctor Lutz. The men already harbored latent malaria when they came into the region and the exertion and exposure incident to the work caused the eruption of the disease.

It must be noted in passing that the character of the disease itself, the duration of the parasites in the human blood, has an important bearing on the insect relation. Thus, in the case of yellow fever and dengue, where the parasites are present in the blood only during a very brief period, the association of the two hosts must be a very intimate one. In the case of malaria, where the parasites are present in the blood for a long time, the relation of the transmitting mosquito may easily be a less intimate one. But even here it must be remembered that the gametes, the sexual elements which are destined to

[3] James, S. P., and Liston, W. Glen. A Monograph of the Anopheles Mosquitoes of India. Calcutta, 1904 (first edit.).

[4] Lutz, Adolph, Waldmosquitos und Waldmalaria. Centralbl. f. Bakteriol., Parasitenk., u. Infektionskr., Abt. 1, Bd. 33, p. 282-292, 1903.

continue the cycle of the parasite within the mosquito host, are only present and available to the mosquito at definite intervals, and that after a certain time, if no reinfection occurs, these forms disappear altogether.

In conclusion the writer wishes to point out that he is fully aware of a certain class of blood-parasites and transmitters which apparently do not conform to the principles above laid down. One class are the diseases transmitted by ticks, where the parasites are directly transmitted from the tick host to its offspring, and where, for this reason, the insect remains a potential transmitter for a very long period. Another class are the trypanosomes which apparently thrive in a number of different vertebrate hosts and may be transmitted from cattle or wild animals to man. But the observations on this point are by no means conclusive and it is quite possible, as has been repeatedly suggested, that a number of organisms, different but indistinguishable, are involved. It may prove that a revision of the data from the present viewpoint, may materially alter our conceptions on the subject.

UTILIZATION OF FUNGOUS PARASITES OF COCCIDÆ AND ALEURODIDÆ IN FLORIDA

By J. R. Watson, *Florida Agricultural Experiment Station*

As this station is receiving a number of inquiries concerning the success of the experiments which for several years have been in progress here looking towards the control of our worst citrus pests by means of fungi, it has seemed that perhaps a brief statement on the present status of the subject might not be without interest to readers of the Journal of Economic Entomology. The more so as there seems to be among entomologists a feeling (perhaps well founded as far as most of the states are concerned) of pessimism concerning the practicability of controlling any insect pest by means of its fungous enemies.

Although fungous enemies are here very efficient in checking the ravages of many other insects, as for instance the larvæ of many lepidoptera, the most attention has been given to the scales and to the whiteflies of citrus, and it is with these that the writer will chiefly deal in this brief notice.

History. The presence of parasitic fungi (the Red Aschersonia) was first noted as checking the work of whitefly in Florida by H. J. Webber in 1893 (Report of Fla. Hort. Soc., and Bull. 13 Div. of Veg. Path. U. S. D. A.). Prof. P. H. Rolfs (Fla. Bull. 41, 1897) first noted the Red-headed Scale Fungus (*Sphærostilbe coccophila*) as being a

very efficient enemy of the San José Scale and worked out a method of artificially aiding its dissemination by tying on to the branches of infested trees where the fungus was absent, small twigs on which were scales infested with fungi, and also a method of spraying into the trees water containing the spores obtained from cultures of the fungus in artificial media.

Prof. H. A. Gossard (Bull. 67) took up the artificial spreading of the fungi parasitizing whitefly. Following Webber he recommended the method of transplanting nursery stock on which were parasitized larvae.

The method which is now exclusively used on a commercial scale has been developed by Dr. E. W. Berger (Bulls. 88, 97, and 103, Fla. Exp. Sta. and Annual Reports 1907–11). It is to spray into the trees water in which are held suspended the spores and mycelia of the fungi. He found that the spores from about 40 fungus pustules to one pint of water was sufficient and that the leaves may be kept six months or more in cold storage, thus obviating one frequent difficulty, that of finding fungous material in the spring and early summer following the dry season. Or fungi may be used which have been grown on sweet-potato or other artificial media.

Prof. H. S. Fawcett, Plant Pathologist of the station, and Director P. H. Rolfs have worked on the life-histories of the fungi concerned and the methods of their propagation on artificial media (Bulls. 41 and 94 and Univ. Fla. Special Studies No. 1, 1908, Mycologia II 4, 1910).

Scales. The scale which is most widespread and has received the most attention lately is the citrus Purple Scale (*Lepidosaphes beckii*) and the following remarks apply chiefly to it, although many others seem to be affected to about the same degree. The chief fungi concerned are, the Red-Headed (*Sphaerostilbe coccophila*), the Black Fungus (*Myriangium duriaei*), and the White-headed (*Ophionectria coccicola*).

It is not the object of this paper to go fully into the historical aspects of this subject as that has been done elsewhere (Berger Rep. of Fla. Hort. Soc. 1911), but it is well in passing to call attention to the fact that when this scale was first introduced and before the fungi had commenced to be effective, it was regarded as a much more serious pest than is now the case. So serious indeed that the very existence of the citrus industry seemed to be threatened. Even with no attention on the part of the grower and no efforts to aid in their dissemination, the fungi are very efficient aids in holding the scale in check. To what an extent this is true can be seen from the accompanying table (Table I) in the column showing the effect of spraying with Bordeaux mixture. It has long been recognized that spraying with this standard

fungicide immensely increased the number of scales present. Heretofore there has been no careful quantitative data as to what extent this is true, but during the past summer such experiments were carried on by Professor Fawcett and the results are given in the accompanying table. Ten representative oranges and fifty representative leaves were taken from each plot and counts (or estimates in the case of those oranges from the Bordeaux plots) were made of the scales and whiteflies on each. The figures in the table are the averages. These trees were sprayed in June, in July, and on August 31.

TABLE I

	Scales on fruit			On leaves		
	Sept. 1	Oct. 25	Nov. 28	Sept. 1	Oct. 25	Nov. 28
Check	25.7	52	70	33.4	10	[illegible]
Sprayed	370.0	2559	6835	175.6	155	[illegible]

The Bordeaux mixture by killing the parasitic fungi allows the unhindered multiplication of the scales and gives us some idea as to what they would do were they not naturally held in check by the fungi. The Bordeaux column, then, and not the unsprayed trees should be regarded as the "check" in considering the efficiency of the fungi. Even then, however, we do not get a true picture of the importance of the fungi as these trees were covered with the fungicide for only a few months, whereas it should have been extended over several years to give us a true check. Also they were surrounded on all sides by fungous-covered trees which reinfected them before the last count. Nevertheless this gives us some idea of the rôle that these parasitic fungi naturally play in the citrus groves of Florida and demonstrate the truth of the statement of Doctor Berger that "It is the fungi that keep the grower in business."

Whitefly. The chief fungi concerned in keeping in check *Aleyrodes citri* R & H and *A. nubifera* Berger are, in the order of their importance, the Red Aschersonia (*A. aleyrodis*), the Brown Fungus (*Aegerita webberii*), the Cinnamon (*Verticillium heterocladum*), the White Fringe (*Microcera* sp.), and the Yellow Aschersonia (*A. flavo-citrina* on *Aleurodes nubifera* only. The first three and the last attract the larva and pupa, the fourth, all stages. This is also a complete saprophyte, developing in immense numbers on the bodies of insects killed by fumigation. They are all partial saprophytes since the major part of their development occurs after the insect is dead and they can all be raised on artificial media.

What was said about the efficiency of the fungi in keeping down the

sca[le] even when not aided by the grower applies equally well to the wh[ite]fly. It has long been recognized that even when no means were tak[en] to combat it, the grower could reasonably hope to get about ever[y] third year a crop nearly free from the sooty-mold (Meliola) that dev[el]ops in the honeydew given off by the whitefly and constitutes one of its chief injuries. Bordeaux mixture produces, here also, a rapid increase in numbers when sprayed on trees.

But the unaided spread of the fungi is often slow and very uneven. This is true not only of its spread from grove to grove as would be expected, but frequently from tree to tree in the same grove and sometimes from one part of a tree to another. As an illustration of this some counts taken by the writer in December, 1911, will be cited. Fifty leaves were taken at random from a grove with a conspicuous amount of fungus and counts were made of the number of whitefly alive, of the number surely killed by the Brown Fungus and Red Aschersonia as shown by well-developed pustules, the number dead from other causes including "natural mortality," and the number of empty pupa cases showing successful emergence. Most of those in column three were really killed by fungi which had not developed sufficiently to show pustules. Recent study by the author has shown pretty clearly that the so-called "natural mortality" is due to the White-fringe Fungus that does not develop the characteristic fringe as it does under favorable circumstances. The counts of some of the leaves and the average of them all is given in Table II.

TABLE II

Alive	Fungus pustules	Dead, no pustules	Emerged	
0	775	10	120	
0	100	2	8	
140	1	8	0	
[illegible]	8	0	0	
520	100	107	58	
470	5	150	225	
0	600	200	1	
520	1	84	240	
75.0	120.4	74.6	32.4	Average of the 50 leaves.
23.3	40.1	24.8	10.8	Per cent of the whole number.

This table does not show the real mortality as it does not take into consideration those that died and dropped off. It is not given as an example of the efficiency of the fungi as it was taken in the most unfavorable time of year, but it shows the unevenness of the distribution. It is shown, however, that even at this time of the year that the fungi had made a clean sweep of the larvæ on 19 of the 50 leaves.

Because of this occasionally slow spread and uneven distribution of

the fungi, it is of advantage to thoroughly spray the grove with spores, even when there is much fungus present. This has been abundantly proven in field experiments by Doctor Berger and the experience of commercial sprayers.

Spraying on a Commercial Scale. The method has been taken up very extensively by the growers of the state and several parties make it their business during the summer season. One alone of these commercial sprayers treated a hundred thousand trees last summer belonging to over a hundred growers and sold fungi to as many more who applied it themselves. Several others sprayed from fifteen to fifty thousand each, and a very large number of growers sprayed their own trees. Altogether during the last few years between one and two million trees have been thus treated.

Conclusion. Although some very good results have attended their use at other times, such as March and April, as is to be expected, the fungi do their most efficient work during the warm rainy summer (from about June to the middle of September).

We do not advise the grower always to depend upon the fungi alone, at least not in the case of a severe infestation during the dry season. Then it is frequently desirable, or even necessary, to use some heavy-oil insecticide to supplement the work of the fungi. Or fumigation with hydrocyanic acid gas can be used in isolated groves or communities.

It would seem that the practicability, in Florida, of combating insects by means of aiding in the distribution of their fungous enemies, at least in connection with other methods, has been sufficiently demonstrated to warrant a thorough trial in all other moist, sub-tropical or tropical countries. The method has already been successfully used against scales in Trinidad, Montserrat, and Barbados (Report of the Local Dep. of Agri., Barbados 1910–11; W. I. Bull. Vol. XI No. 1).

AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

The following appointments are announced for the current year:

Committee on Membership, H. E. Summers, Chairman, Wilmon Newell and R. A. Cooley.

Committee on Entomological Investigations, T. J. Headlee, Chairman, Glenn W. Herrick, and W. C. O'Kane.

W. D. HUNTER, *President.*

AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS.

At the last annual meeting of the association it was voted that the President and Secretary arrange to organize an employment bureau for entomologists.

Prof. F. L. Washburn, St. Anthony Park, Minn., has been selected to take charge of this work and entomologists desiring positions or institutions desiring entomologists should communicate with him.

A. F. BURGESS, *Sec.*

Proceedings of the Tenth Annual Meeting of the American Association of Official Horticultural Inspectors—(*Continued*)

Second Session December 29, 1.30 p. m., New National Museum

Meeting was called to order by President Sherman who introduced Dr. S. A. Forbes.

WHAT SHOULD THE STATE REQUIRE OF A NEGLIGENT OWNER OF A DANGEROUS ORCHARD?

By STEPHEN A. FORBES, *Illinois State Entomologist*

In suggesting this topic for this meeting—and I believe it was placed upon our programme at my request—I had no intention of preparing a paper upon it myself, but thought merely of obtaining a discussion of it in the hope that we might have a comparison of ideas and methods which would be helpful to us all. Perhaps the best way for me to open such a discussion is to describe to you the situation as it has developed in my own state, and the solution of our problem at which we have lately arrived.

I have been at work now for several years in Illinois, under our inspection law, upon what has come to appear as an impracticable programme. Under our law, dangerously infested orchards and other such property are a public nuisance, the maintenance of which, after due notice and requirement, is punishable as a misdemeanor; but the failure of the owner of such dangerous property to suppress the nuisance pointed out to him has been followed by an effort to suppress it on my part, the expenses of the operation to be collected from the negligent owner, who is further liable to prosecution and fine.

This system works out in the following manner: I can only determine whether premises are so infested as to be dangerous to adjacent property by an inspection made in the fall after the leaves have dropped, and after the season of multiplication of the San José scale is virtually over. With the area now to be covered by such inspections in Illinois, the whole early part of the winter is required to take this first step. I must then notify the responsible owner of the existence of the nuisance on his premises, and must prescribe methods for its removal, giving him, of course, sufficient time to make his preparations and do this work; and his work must be done in time to permit me to make a second general inspection throughout the whole territory infested, to ascertain whether these nuisances have actually been

suppressed—whether the necessary spraying has been done and done effectively. And this second inspection must be completed in time to allow me to follow it up with an effective general spraying operation, wherever the dangerous conditions have not been wholly removed. But the first inspection being made during the early part of the winter, and active spraying being impracticable or useless with us in the midwinter months, orchard treatment must go over in the main until towards spring, and the season during which effective treatment is possible will be gone before all these various steps can be taken in succession. We have of late, consequently, been obliged to limit our operations to a part of the territory to be covered, in order that we might get over it all in time; and elsewhere we have had to trust to the owners of dangerous properties for such spraying as we could induce them to do. Enough orchards have thus been left untreated at the end of the season to cause vigorous complaint both on the part of those who have felt themselves compelled to spray and on the part of the commercial orchardists who take the best care they can of their property but who find their carefully treated trees still endangered by the neglect of their neighbors.

I have been asked this fall, in fact, by our State Horticultural Society, to prepare a description of the legislation necessary to compel the destruction of dangerous orchards and other such property which the owner is persistently neglecting to the disadvantage and loss of his neighbor. I thought it well, however, to learn first just what powers I had under our present law, and consequently put the question to the Attorney-General of the state, who replied to the effect that our Illinois law already clearly contemplates the enforced destruction of dangerous property where I deem this necessary to the safety of other property adjacent, and that I am warranted in proceeding upon that interpretation provided that I am careful to keep strictly within the letter of the law. I have consequently changed this fall the form of notice given to owners of dangerously infested properties in a manner to advise them that their infested trees and shrubs must be either effectively sprayed or dug up and destroyed by the first of April, and that, if found at that time to be still dangerously infested, they must be destroyed by the first of the following June. In other words, I have put myself in position to enforce effective treatment of infested property under a penalty of a destruction of the infested stock, provided this treatment is not administered in due time.

The attitude of our leading horticulturists upon that subject is shown by a resolution presented at the last meeting of the State Society by a special committee on this subject, and unanimously adopted by the Society in the following terms: "Resolved, that the welfare

of horticulture and the best interests of the intelligent and responsible horticulturist require the prompt suppression of all dangerous horticultural nuisances as these are defined in our state inspection laws, and that we approve and will support the State Entomologist in all necessary lawful measures to that end. This statement is intended to include the destruction of infested or infected trees and shrubs neglected by the owner, and so situated as to be dangerous to the property of others." I shall hope to have the experience and the judgment of others upon the situations thus described.

One other point may be interesting to you, and that is the real extent and scope of some of our laws passed with primary reference to the San José scale. We have some of us sown a seed that will produce a crop quite different from what we had in mind when sowing. I am advised by the Attorney-General of Illinois that our so-called San José scale law, although designed and drawn especially for the control of the San José scale, is expressed in terms so general (in order to make it cover all possible cases) that it really applies to insect pests of every description as affecting any kind of property whatsoever. He tells me, in other words, that I have the same powers and obligations with respect to a wheat field infested by chinch-bugs likely to escape at harvest time to the injury of the corn of an adjacent neighbor that I have with reference to the San José scale in an infested orchard. We have thus obtained a general crop-pest law in Illinois without knowing it or, indeed, intending it at the time; and I am making some use of this fact this winter to arouse attention to the chinch-bug situation in the southern part of our state, by showing farmers concerned that by an attitude of indifference and inactivity with reference to their infested fields they are really violating a law of the state.

A RECENT DECISION OF THE SUPREME COURT OF KANSAS

By S. J. Hunter, *State Entomologist, University of Kansas, Lawrence*

[Professor Hunter outlined the history of the case and called attention to the far-reaching significance of the decision, which latter is reproduced below.—Ed.]

No. 17226.

S. W. Balch, Appellant,

v.

A. P. Glenn, *et al.*, Appellees.

Appeal from Sedgwick County.

Affirmed.

SYLLABUS BY THE COURT.
PORTER, J.

1. The statute creating the Entomological Commission and providing for the extermination of San José scale and other orchard pests (Gen. Stat. 1901, ch. 108, art. 43) is a valid exercise of the police power.

2. The statute is not invalid because it delegates to the commission the power to declare the existence of conditions which call into operation the provisions of the statute.

3. The legislature may declare that to be a nuisance which is detrimental to the health, morals, peace, or welfare of its citizens, and may confer power upon local boards or tribunals to exercise the police power of the state when in the judgment of such tribunals the conditions exist which the legislature has declared constitute such nuisance.

4. Nor is the statute in question unconstitutional on the ground that it provides for taking private property without due process of law. It rests wholly with the legislature whether, in the exercise of its power of police regulation, the individual whose property is destroyed shall receive compensation therefor.

5. The statute is designed to protect and promote the horticultural interests of the state and, in effect, makes all orchards, trees, shrubs and plants, infested with the pests mentioned in the statute public nuisances, and being a proper exercise of the police power is not unconstitutional because it authorizes the expense of abating such nuisance to be charged against the property of the owner.

6. Nor is the statute unconstitutional because no separate tribunal is provided by which the owner may contest the amount of expense which shall be charged against his property. The act requires notice to be served upon the owner stating the amount of expense incurred by the Commission and notifying him that unless such expense is paid within twenty days the same will be taxed against his property. *Held*, that, ample notice being provided which gives property owner an opportunity to question the amount of such expense in an action in any court of competent jurisdiction before his property is affected, he is afforded due process of law.

7. The lien given by the statute upon premises for the expense of abating such nuisance thereon is not for a delinquent tax but for indebtedness due the county and the provision authorizing such expense to be collected as other taxes are collected is not obnoxious to any constitutional inhibition.

All the Justices concurring.

A true copy. Attest:

Clerk Supreme Court.

The opinion of the court was delivered by

PORTER, J.: In this suit the appellant challenges the validity of chapter 386 of the Session Laws of 1907, as amended by chapter 27 of the Session Laws of 1909, creating the Entomological Commission and providing for the extermination of San José scale. Appellant is the owner of a large orchard of apple and peach trees, grapes and other fruit and sued to enjoin the defendants from entering upon his premises for the purpose of inspecting, spraying and destroying the fruit trees and vines and from causing the expenses incurred in the performance of such services to be taxed against his property. In their answer appellees admitted that they were about to inspect, and, if necessary, destroy the trees, vines and other shrubbery on appellant's premises and that the costs and expenses incurred by them would be taxed against his property: they alleged that appellant's orchard is infected with San José scale and asked that he be enjoined from interfering in any manner with the work of the commission in exterminating the same. On the trial the court found the proceedings of the appellees justified and enjoined appellant from interfering with the proceedings. From this judgment he appeals.

Chapter 386 of the laws of 1907 creates the entomological commission, to consist of the secretary of the State Board of Agriculture, the secretary of the Kansas State Horticultural Society, the professor of entomology of the University of Kansas, the professor of entomology at the State Agricultural College, and a nurseryman actively engaged in the nursery business within the state, to be appointed by the governor. The purpose of the act is the suppression and extermination of San José scale and other injurious insect pests and plant diseases. In order to accomplish such purpose the entomologists, their assistants and employees, are authorized to enter upon the premises of any private individual and inspect, destroy, treat, or experiment upon such insects or plant diseases. In case the officers mentioned or their employees shall find such insects or diseases to exist they are required to mark in some conspicuous way all trees, vines, shrubs, or plants so infested, and to give notice in writing to the owner, tenant, or person in charge of the premises, of the condition thereof. The act then provides that if the owner or person in charge shall not within ten days thereafter destroy or treat the same in accordance with the regulations and rules of the commission, the commission shall cause the work to be done. The act of 1907 provided that the expenses of such extermination or treatment, properly certified by the commission, should be collected by the county attorney of the county where such premises are located, who was directed to account therefor to the commission. The legislature of 1909 amended the act so as to provide that the expense incurred in inspecting, treating, and exterminating such insect pests should be paid by the owner of the premises within a certain time after the services were performed, in default of which it should be taxed against the property and collected in the same manner as delinquent taxes. The amendment, so far as it relates to the present controversy, reads as follows:

"The necessary expense thereof shall be paid by the owner or owners of the real estate from which said infestation has been removed in pursuance of this act. The state entomologist or his deputy shall serve or cause to be served upon said owner or any one in possession and in charge, of said real estate, a notice, stating the amount of said charge, and further stating that if said charge be not paid to the county treasurer of the county wherein said real estate is located within twenty days from the service of said notice, that the same will become a lien upon said real estate. Copy of said notice, together with the proof of service, shall be at once filed with the county clerk, and if said amount is not paid within the time therein stated said county clerk shall spread the same upon the tax-roll prepared by him and said amount shall

become a lien against said real estate and be collected as other taxes are and said real estate shall be sold for non-payment of said taxes the same hereafter may be provided by law for sale of real estate for delinquent taxes the owner of said real estate not pay said charges within the stated time, shall be presented to the board of county commissioners by the county cle[illegible] them allowed and paid out of the general fund of said county by the county [illegible] and when said amount is collected as taxes it shall be paid into the ge[illegible] of said county. The cost of eradication or treatment of such infestation [illegible] stated, shall be paid to the county treasurer, to whom the county clerk sh[illegible] all amounts due as reported to him by the entomologists in charge. T[illegible] treasurer shall forward to the state treasurer on the first of each month al[illegible] thus received. These amounts shall be paid into the general fund of the En[illegible] cal Commission." (Laws 1909, ch. 27, Sec. 1, Gen. Stat. 1909, Sec. 873[illegible]

There was ample evidence to warrant the finding that appellant's [illegible] infected with San José scale. It is conceded that the appellees were atte[illegible] follow the provisions of the statute. They and their employees had gone [illegible] premises of the appellant and had marked certain trees and shrubs for [illegible] and had marked others for treatment by spraying; they had given the [illegible] due notice in writing ordering him within ten days thereafter to treat and [illegible] the pest under the rules and regulations of the commission. Upon his [illegible] comply with the order the commission was about to cause the work to [illegible] and the expense thereof charged against appellant's property.

The appellant asserts that the act of 1907 as amended by that of 1909 is [illegible] stitutional. Generally stated his contentions are, that the law deprives him [illegible] property without due process of law and therefore violates the 14th [illegible] to the federal constitution; that it deprives him of the right to a jury trial [illegible] tion of section 5 of the Bill of Rights; that it attempts to confer judicial power [illegible] the commission and its employees and to give them authority to determine the [illegible] of taxes which shall be assessed against the appellant's property without [illegible] opportunity to contest the amount thereof; that it violates section 1 of article [illegible] the constitution of Kansas requiring a uniform and equal rate of assessment [illegible] taxation. Little if any attempt is made in the brief to argue these propos[illegible] separately; but counsel for appellant urge the following specific objections [illegible] statute: (1) that there is no method of procedure or hearing provided by [illegible] appellant's right to protest against the destruction of his property is pre[illegible] that the law delegates to the commission and its employees the power to mark [illegible] for destruction without a hearing or trial as to the necessity thereof; (2) [illegible] fails to prescribe any compensation for property destroyed, whether tak[illegible] or wrongfully; (3) that no notice or opportunity is provided by which the [illegible] may contest the amount of the expenses which shall be taxed against his [illegible] Most of these objections rest upon what appears to be a failure to distingui[illegible] the exercise of the power of eminent domain and the exercise of the pow[illegible] regulation. Many cases are cited where legislative enactments have [illegible] invalid on the ground that they provide for the taking of private property [illegible] use without compensation. These authorities have no application to [illegible] case. The courts have universally recognized the distinction betwe[illegible] powers. Under the exercise of the one private property cannot be t[illegible] for public or private use without compensation; in the exercise of the o[illegible] of property may be limited, or controlled, or the property itself destro[illegible] any compensation therefor being made to the owner. It is no objection to [illegible] of laws passed in the proper and lawful exercise of the police power th[illegible] is not made for compensation to the individual whose property may [illegible]

Property taken or destroyed for the purpose of abating a nuisance or ...t the spreading of a pestilence is not taken for public use. All private ...s held subject to such reasonable restraints and burdens as in the opinion ...gislature will secure and maintain the general welfare and prosperity of ... It is held subject to the obligation that it shall not be used so as to affect ... the rights of the community. It belongs to the legislative branch of ...rnment "to exert what are known as police powers of the state, and to deter... ...narily what measures are appropriate, or needful, for the protection of the ...morals, the public health, or the public safety." (Mugler v. Kansas, 123 ... 623-661; 31 L. ed. 205. Mo. Pac. Rly. Co. v. Finley, 38 Kan. 550, 16 Pac. 951

In the exercise of this power the legislature may be justified in excluding property ...rous to the property of the citizens of the state, as, for example, animals having ...ous or contagious diseases. The police power is said to be inherent in govern... but can only be exercised by authority of legislative enactment. It is for ...legislature to determine what laws are needed and appropriate to promote the ...ic welfare and to prevent the infliction of public injury. So long as the legis...ure, in attempting to exercise this power, does not violate any of the provisions of ...organic law or encroach upon some power vested in Congress by the federal ...stitution, the exercise of its discretion is not subject to review by the courts. ...atter of Application of Jacobs, 98 N. Y. 98, 50 Am. Rep. 636.) In the language ...Justice Gray, in Blair & Hutchinson & Smith v. Forehand, 100 Mass. 136.

"All rights of property are held subject to such reasonable control and regulation ...the mode of keeping and use as the legislature, under the police power vested in ...m by the constitution of the commonwealth, may think necessary for the pre...ting of injuries to the rights of others and the security of the public health and ...fare. In the exercise of this power, the legislature may not only provide that ...tain kinds of property (either absolutely or when held in such a manner or under ...ch circumstances as to be injurious, dangerous or noxious) may be seized and ...fiscated upon legal process after notice and hearing; but may also, when necessary ...nsure public safety, authorize them to be summarily destroyed by the municipal ...thorities without previous notice to the owner as in the familiar cases of pulling ...n buildings to prevent the spreading of a conflagration or the impending fall ...the buildings themselves, throwing overboard decaying or infected food, or abating ...er nuisances dangerous to health." (p. 139-140.)

It cannot be doubted that the legislature possessed the power to declare that the ...stence of the San José scale, which is well known to be injurious and dangerous ...the fruit industry of the state, constitutes a nuisance. The evidence in the case ...bar shows beyond question that this particular pest is so prevalent in Sedgwick ...nty as to become a source of great danger to the fruit growers in the community, ...well as to those in other sections of the state. The statute viewed in the light of ...e evidence and aided by facts which common experience and observation teach ...ecting the danger to an important industry of the state from the presence of ...ch pests must be regarded as appropriate and well calculated to accomplish ...e purpose of the legislature and therefore a proper exercise of the police power. ...ilar laws have been upheld in other states. Thus in County of Los Angeles v. ...ier, 126 Cal. 670, 59 Pac. 202, 77 Am. St. Rep. 217, it was said:

"It ...nown that the existence of the fruit industry in the state depends upon the ...ppres...n and destruction of the pest mentioned in the statute. The act in ques...on is ...erefore, a proper exercise of the police power which the legislature has, ...nder ...ion 1 of article 19 of the constitution, to subject private property to such ...reasonable restraints and burdens as will secure and maintain the general welfare

and prosperity of the state: Abeel *v.* Clark, 84 Cal. 226; Train *v.* Boston D[illegible] Co., 144 Mass. 523, 59 Am. Rep. 113." (p. 673.)

The law in question here is of the same character as are the quaran[illegible] pertaining to Texas cattle and splenic fever, which the legislature has [illegible] the purpose of preventing the infection of cattle and other live stock. It [illegible] the miscellaneous cases referred to by Judge Cooley in his Constitution[illegible] tions, as follows:

"And there are other cases where it becomes necessary for the public [illegible] to interfere with the control by individuals of their property, and even to [illegible] where the owners themselves have fully observed all their duties to their [illegible] to the State, but where, nevertheless, some controlling public necessity [illegible] the interference or destruction. A strong instance of this description [illegible] becomes necessary to take, use, or destroy the private property of indiv[illegible] prevent the spreading of a fire, the ravages of a pestilence, the advance of [illegible] army, or any other great public calamity. Here the individual is in no [illegible] fault, but his interest must yield to that 'necessity' which 'knows no law.'" ([illegible] Constitutional Limitations, 7th ed., p. 878.)

Cases sometimes arise where the exigencies of the situation require privat[illegible] to be destroyed immediately in order to prevent the spread of pestilence [illegible] other calamity, and where, under all circumstances, the loss which the [illegible] suffers is so inconsiderable in comparison with the benefit to the public that [illegible] opinion of the legislature he is regarded as fully compensated by his individ[illegible] in the benefit accruing to the public. Other cases will arise where it is appar[illegible] if no action is taken by the State the property of the individual will be de[illegible] or rendered of little or no value. In Shafford *v.* Brown, 49 Was. 307, 95 Pac. [illegible] the supreme court of Washington had under consideration a statute giving [illegible] to a county fruit inspector to destroy fruit infected with insects and held the [illegible] owner of such fruit had no cause of action against the inspector for damages [illegible] destruction for the reason that it had no value.

It is true that in some of the laws providing for the abatement of nuisance[illegible] legislature has made provision for compensation to the individual for the [illegible] his property where it has been destroyed. Thus the statute authorizing the [illegible] stock sanitary commissioner, when, in his opinion, it shall be necessary, to [illegible] the spread of any contagious or infectious disease among the live stock of this [illegible] to destroy animals with, or which may have been exposed to certain diseases, [illegible] that he shall first cause the animals to be appraised (Gen. Statutes 1909, Sec. [illegible] and the owner is to be paid the value as fixed by the appraisement; but the [illegible] expressly provides that this right of indemnity for such loss shall not extend [illegible] where such animals have been brought into the state in a diseased conditi[illegible] from an infected district or state or brought into the state in violation of [illegible] or quarantine regulation, or to cases where the owner has violated the quar[illegible] law or disregarded any regulation of the sanitary live stock commission[illegible] any case where the animal came into the possession of the claimant with kno[illegible] that it was diseased or had been exposed to contagion. (Gen. Stat. 1909, Sec. [illegible] The same statute (Sec. 9139) provides that in fixing the value of any such [illegible] the commissioner shall be governed by the value thereof at the date of the [illegible] ment, so that the state does not undertake to compensate the owner for any [illegible] occasioned by the disease or infection. And for some reason which the legisla[illegible] deemed sufficient it is further provided in the same section as follows: "The [illegible] animal or animals shall be appraised except those affected with contagi[illegible] pneumonia of cattle or foot-and-mouth disease or such as have been expos[illegible] there[illegible] The legislature acted upon the theory that in the exercise of the police power

purpose of affording protection to the live stock industry of the state it might authorize the destruction of private property, making provision in some cases for full compensation to the owner thereof, in other cases for partial compensation, and in others for no compensation. The act for the protection of domestic animals is not before us and its constitutionality is therefore not in question. Its validity, however, has not, so far as we are aware, been attacked upon any of the grounds urged against the statute now under consideration.

In 1883 the legislature enacted a law providing for the appointment of sheep inspectors and prescribing their duties. (Laws 1883, Ch. 144, Gen. Stat 1909, Secs. 9091-9100.) The act, which seems never to have been assailed as invalid, authorizes such inspectors to order the owner of sheep afflicted with certain diseases to cause the same to be dipped or otherwise treated and when the owner fails to comply with such order, he is subject to a fine which is made a lien upon the sheep. There is a further provision that the inspector shall then cause the sheep to be treated and the costs and expenses shall be charged against the sheep and made a lien thereon which shall be collected in any court of competent jurisdiction.

A similar act was passed by the legislature of 1909 for the suppression of tuberculosis in cattle which authorizes the owner of any animals found to be so infected to deliver them to the sanitary live stock commissioner and to receive from him an order on the board of county commissioners of the county in which the diseased animals are located for fifty per cent. of the appraised value of such animals as if they had not been diseased, provided that no county shall recognize such order unless such animals have been owned in the county at least 120 days prior to the time the tuberculin test was administered to them. (Laws 1909, ch. 169.)

It rests wholly with the legislature to determine whether in the exercise of its power of police regulation the individual whose property is destroyed shall receive compensation therefor. In the statute of which appellant complains no such provision appears. Doubtless the legislature considered, what is most obvious, that no serious hardship is likely to result to the owner of property through the enforcement of its provisions. No tree or shrub is to be destroyed until upon inspection it is found to be so seriously infested with insect pests as to be of no practical value. On the other hand, if its condition is found to be such that it can be preserved by spraying or other treatment, and the owner, after due notice thereof, refuses to give it proper treatment, the state steps in and for the purpose of preventing the spread of the infestation administers the necessary treatment and frequently preserves the property from ultimate destruction. The owner by being compelled to pay the necessary expense incurred in the treatment and preservation of his property is required to pay only what is justly due the state.

There is no force in the objection that the statute is repugnant to the 14th amendment. That clause of the federal constitution does not limit the subjects upon which the police power of the state may be exerted, nor was it designed to interfere with the power of the state to enact laws for the preservation of the health, morals, peace, or welfare of the people. (Mugler *v.* Kansas, 123 U. S. 623, 31 L. ed. 205 Minneapolis Railway Co. *v.* Beckwith, 129 U. S. 26, 32 L. ed. 585. Prohibitory Amendment Cases, 24 Kan. 700.)

In Mugler *v.* Kansas, supra, it was contended that the state, by prohibiting, in its constitution and laws, the manufacture or sale of intoxicating liquors for general purposes as a beverage, deprived the citizen of his property in violation of the 14th amendment. The court held that a prohibition simply upon the use of property for purposes declared by the legislature to be injurious to the health, morals, or safety of the community, "cannot in any just sense be deemed a taking or an appropriation of property for the public benefit" (p. 668-669) for the reason that the owner is

not disturbed in the control or use of his property for lawful purposes nor [illegible] in his right to dispose of it, but its use is forbidden only for certain purposes p[illegible] to the public interests. The court, however, went much further and [illegible] "The destruction, in the exercise of the police power of the State of prope[rty] in violation of law, in maintaining a public nuisance, is not taking of pro[perty for] public use, and does not deprive the owner of it without due process of la[w]." Upon this proposition the late Justice Harlan, in the opinion used this lang[uage]:

"Nor can legislation of that character come within the Fourteenth Am[endment] in any case, unless it is apparent that its real object is not to protect the com[munity] or to promote the general well-being, but, under the guise of police regula[tion], deprive the owner of his liberty and property, without due process of law. [The] power which the States have of prohibiting such use by individuals of their prope[rty] as will be prejudicial to the health, the morals, or the safety of the public, is [not] and, consistently with the existence and safety of organized society, canno[t] be burdened with the condition that the State must compensate such individual ow[ners] for pecuniary losses they may sustain, by reason of their not being permitted [by a] noxious use of their property, to inflict injury upon the community. The exe[rcise] of the police power by the destruction of property which is in itself a public nuis[ance], or the prohibition of its use in a particular way, whereby its value becomes depre-ciated, is very different from taking property for public use, or from depriving a pers[on] of his property without due process of law. In the one case, a nuisance [illegible] abated; in the other, unoffending property is taken away from an innocent holde[r]." (123 U. S., p. 669.)

The statute is not invalid because it delegates to the commission the power [to] declare the existence of conditions which call into operation the provisions of [the] statute. The legislature of the State may declare that to be a nuisance which [is] detrimental to the health, morals, peace, or welfare of its citizens, and may [confer] power upon local boards or tribunals to exercise the police power of the state wh[en] in the judgment of such tribunals the conditions exist which the legislature ha[s] declared constitute such nuisance. Similar power has been conferred upon [cities] of the first class to remove certain nuisances, and to tax the costs of the proceed[ings] upon the property where the nuisances are located. (Gen. Stat. 1909, Sec [illegible]) Like authority is conferred upon the sanitary live stock commissioner to determ[ine] that domestic cattle or live stock are infested with certain contagious diseases. (Gen. Stat. 1909, Sec. 9136.)

The legislature of the State may declare that a nuisance, which is such in [illegible] may create a commission with a power to determine whether the conditions [illegible] by the act exist." (Cooley, Constitutional Limitations, 7th ed., p. 882, n. 1.)

In determining whether the conditions exist which the legislature declares const[i]-tutes a nuisance, that is, whether a particular orchard or some portion [illegible] so infested with insect pests as to require treatment or extermination, the com[mission] exercises some discretion which is in a limited sense judicial, but no more so [than] discretion generally exercised in the enforcement of police regulations. [illegible] the discretion exercised by inspectors of health, food, grain, milk, live stoc[k], by [the] various state boards and commissions, and by city officers charged with th[e enforce]-ment of police regulations, which in order to be effective, often require pr[ompt and] summary execution, and which from their nature call for the exercise of m[illegible] discretion in the officers whose duty it is to make them effective.

The same objection was urged against the act creating the board of rail[road com]-missioners and acts supplementary thereto. It was held that although [the board] is required to exercise judgment and discretion and to make orders for the [regulation] and control of railroads and other common carriers, the act does not co[nfer upon]

the le... either executive or judicial powers. (The State v. Railway Co., 76 Kan. 467, ... Pac. 606. To the same effect is Schaake v. Dolley, ante, p. 598, 118 Pac. 80, where it was held that the granting or refusing of an application for a bank charter by the charter board calls for the exercise of discretion and that the act creating the board is not invalid because it provides that the board shall refuse a bank charter if upon examination it shall determine against the public necessity of such business in the community in which it is sought to establish such a bank. The statutes construed in both of the foregoing cases were passed by the legislature under the police power of the state. The precise question was before the supreme court of California in County of Los Angeles v. Spencer, 126 Cal. 670, 59 Pac. 202, 77 Am. St. 217, where a statute almost identical with this was construed, and it was held that:

"A statute designed to protect and promote the horticultural interests of the state, which declares that all places, orchards, etc., infested with the pests mentioned in the statute are public nuisances, and which act is a proper exercise of the police power, is not unconstitutional on the ground that it confers judicial powers upon the horticultural commissioners, where a commissioner, in determining whether any particular place is a nuisance, must necessarily exercise some discretion which, in a strict sense, is judicial in its nature." 77 Am. St. Rep., Headnote. (Syl. par. 3.)

Nor is the act invalid because no procedure or method is provided by which the owner may contest the necessity for the destruction of his property. The exigencies of the situation and the conditions which the legislature had in mind require prompt and summary action. The fruit industry of a large portion of the state might be jeopardized by delays resulting from almost any method or procedure which could be devised by which the owner could have a hearing as to the necessity for the destruction of his property. If his orchard is infested with the dangerous pests which the statute was designed to exterminate the legislature declares the condition to constitute a nuisance which the interests of the state require shall be abated promptly and summarily. In order that private property might not be liable to destruction under the provisions of the statute, except where the conditions actually exist, the legislature provided that the commission shall be composed of persons possessing a scientific and practical knowledge of horticulture. And when those persons have determined that an orchard or some portion of it is infested with such insect pests it would seem that the question is one about which there could be little room for reasonable minds to differ. Under the police power the legislature may, when necessary, authorize the seizure and confiscation or destruction of private property without previous notice to the owner. (Blair & Hutchinson & Smith v. Forehand, 100 Mass. 136.)

It is urged that the act is unconstitutional because it authorizes the cost of the proceedings to be charged against the property of the owner without notice to him or opportunity to question the amount thereof. The act, however, requires notice in writing to be served upon the owner stating the amount of expense incurred by the commission and notifying him that unless the same be paid within twenty days the same will be taxed against his property. He therefore has notice before any lien is created upon his property, and before it can be taken or sold. Having this notice he is relegated to his common-law remedies. If he believes the amount charged is greater than it should be, he has ample time to determine what is the proper charge, tender the same to the county clerk and enjoin in any court of competent jurisdiction the collection of a greater amount. It has been held by the Supreme Court of the United States that the phrase "due process of law" does not necessarily mean a judicial proceeding. (McMillen v. Anderson, 95 U. S. 37-41.) On the other hand it does not necessarily mean a special tribunal created for the

express purpose of hearing the merits of the particular controversy. When ample notice is provided which gives the property owner an opportunity to have a hearing in any court of competent jurisdiction before his property is affected he is afforded due process of law.

But we do not regard the cost of the proceedings a tax, although they are made to it as a tax to "be collected as other taxes are collected." It is merely the expense of abating a nuisance and there are various ways which the legislature might have adopted for its collection. They might have provided for its collection by an action against the owner, after his neglect or refusal, upon due notice, to abate the nuisance, following the method provided for collecting the cost and expenses of inspecting and treating diseased sheep (Gen. Stat. 1909, Sec. 9097); or, the method prescribed where infected cattle are taken by order of the sanitary live stock commissioner; see section 9136 (Gen. Stat. 1909), which provides that all costs and expenses shall be paid by the owner and if not so paid, the animals shall be advertised and sold in the same manner as personal property on execution.

Instead of adopting either of these methods the legislature provided that the cost of abating the nuisance should be paid by the owner of the property, and in default of such payment the board of county commissioners should pay it so that the work of the commission should not be delayed; and then gave the county a lien upon the real estate for the indebtedness due it from the owner and authorized the county to enforce such lien by the method employed in levying and collection of taxes. The California statute gives to the county a lien upon the real estate for the expenses incurred and provides for its enforcement by an ordinary action. It was held that the lien is not for a delinquent tax but merely for an indebtedness due to the county (County of Los Angeles *v.* Spencer, supra.)

Since the expense incurred by the commission is not a tax the act is not repugnant to the provision of the constitution which requires a uniform and equal rate of assessment and taxation.

The act being constitutional and valid the court properly denied the appellant the relief prayed for and the appellees were entitled to a permanent injunction against his interfering with the execution of the law.

The judgment is affirmed.

All the Justices concurring.

A true copy. Attest:— Clerk Supreme Court.

THE ADVISABILITY OF EXEMPTING FROM FUMIGATION NURSERY STOCK NOT SUSCEPTIBLE TO SAN JOSÉ ATTACK

By P. A. Glenn, *Chief Inspector, Office of State Entomologist, Urbana, Ill.*

The San José scale is present in so many of our states and has established itself in dangerous proximity to so many of our nurseries that the problem of preventing its further dissemination on nursery stock and of giving to the buyer of nursery stock the advantage which is rightly his, of having trees to start with that are free from this troublesome pest, is one of the most important ones with which the inspection departments of most of our states in which nursery stock is grown extensively have to deal; and, moreover, nursery stock is so extensively

shipped from state to state that it becomes a matter of great importance in each state how the problem is handled in others from which they receive shipments.

Some states endeavor to protect themselves by undertaking to inspect at the point of delivery all stock shipped into them; and, though this is an expensive program to carry out successfully, there is no doubt that it is worth many times more to the state in the way of protection against the introduction of insect pests than it costs. But, in the large majority of the states, the appropriations available for inspection purposes are too small to enable them to make such inspections in addition to the inspection of the stock grown within them. They must, consequently, depend to a very large extent for protection on inspections made in other states, and are of necessity almost compelled to accept at their face value the certificates which accompany shipments. Thirty-seven states thus accept the certificates from other states when signed by an authorized official of the state in which the shipments originate. Nine of these require, in addition to the certificate of inspection, a certificate of fumigation. Three will accept a certificate of fumigation in lieu of a certificate of inspection. Nine states accept no certificates, but subject all shipments to inspection. Two states have no regulations.

Since so many states have interests in common, and are, of necessity, dependent each upon the other for protection, it seems that some uniform regulations ought to be adopted that will be just to the growers of nursery stock on the one hand and adequately protect the buyers on the other, and will make it possible for one state to honor the certificates of other states with safety. We may not be able to secure uniform laws, but in nearly all the states the laws as they now stand require the inspection of growing stock yearly, and they also in nearly every case give to the entomologist in charge the authority to prescribe the treatment necessary when San José scale is present, so that the lack of uniformity of regulations in respect to San José scale is not so much a matter of law as it is of regulations by authorized officials, made by them in the exercise of their discretionary powers. A much greater degree of uniformity may, therefore, be had if it is desired.

In making regulations two extremes are to be avoided, that of being too exacting on the one hand, and too lenient on the other. Nothing is gained by the former course except, perhaps, the ill will and opposition of the nurserymen, whose coöperation is absolutely essential to our success. On the other hand, if there is too great leniency, and the interests of the public are not adequately safeguarded, we betray an exceedingly important trust.

In this paper the discussion relates to nursery stock that has been exposed to San José scale attack. This condition is necessarily a very uncertain one, as it depends on so many points upon which we have no definite data, such as the distance which birds, insects, squirrels and other animals that frequent trees will travel from one tree to another, and the distance which the young insects may be blown by the wind, and on other conditions which vary so much, that they are never just the same in any two cases, such as the number and degree of infestation of the trees or shrubs which constitute the origin of infestation. It is the general supposition that nursery stock standing through the growing season within a half mile of infested trees is exposed to infestation. If the origin of infestation should be only a few trees or a single small tree, and the degree of infestation slight and not of long standing, the distance within which stock is considered as exposed to attack is correspondingly less. However, this does not concern us now. The inspector must determine in each case whether or not stock is exposed to infestation after taking into consideration all the circumstances. Our discussion relates to the kinds of stock, or rather species of trees and shrubs, that should be fumigated on account of exposure to San José scale attack, and species that may safely be exempt from fumigation.

In those states which have any regulations, all, with three possible exceptions, require that all stock known to be infested be destroyed. In a little more than half of them the practice is to require the fumigation with hydrocyanic acid gas of all the remaining deciduous stock which may be safely fumigated; in a smaller number the practice is to exempt stock not subject to attack, and in one state at least, the exemption extends to all stock except certain fruit trees.

The question as to what stock should be fumigated, and what may safely be exempt ought not to be difficult to determine. Our experience with the San José scale has been extensive enough to indicate to us what stock is subject to attack and what is not. Doctor Britton's lists, which represent the results of the experience of those whose observations have been the most extensive, with a slight revision which can be made as the results of observations made since their first publication, will serve as our best guide in determining this point.

To require the fumigation of species of trees and shrubs that have never been known to be infested with the scale, though exposed to attack, is going to extremes. It places a burden upon the nurserymen that is, so far as we are able to demonstrate, useless. It is not a matter of so much importance to the nurserymen who grow mostly or entirely fruit stock, and little or no ornamental stock not susceptible to attack. The fumigation of their small amount of nonsusceptible

st[ock] adds little to their trouble and expense; but with the nurseries ha[vin]g from fifty to five hundred acres or more of ornamental stock, mu[ch] of which is not susceptible, the case is quite different.

[On]e of the best firms in our state recently wrote us as follows:

"Your sweeping regulations add needlessly to the cost. The result is either to cut down profits, or, by making one do his own interpreting, callous one's moral motives.

The removing of this handicap, with reasonable restrictions, would greatly help. . . . We sell large shrubs with balls of earth, and the several handlings shake much of the soil off and crush the roots."

The nurserymen have a just cause for complaint, and are entitled to just treatment. The honest nurserymen are in favor of proper restrictions, and when they are made, will coöperate in good faith; the dishonest ones will evade all restrictions possible, and the more exacting the restrictions are, the more they will evade them.

The practice of requiring the fumigation of all deciduous stock prevails in a majority of the states. They follow it, in most cases, not because it is regarded as necessary for adequate protection, but rather to avoid complicating matters by making exceptions, and to keep up the high standard maintained in other states in which they desire their certificates to be honored. If it were generally understood that making exemptions, with proper restrictions, would not tend to discredit their certificates, some states would be glad to abandon the practice. Judging from replies received from the entomologists of nearly all the states to a question bearing on this point, it appears that such exemptions would not interfere with the honoring of certificates except in about half a dozen states.

It is a fact well known to all that the scale is being disseminated more or less on nursery stock in spite of efforts to prevent it. But it is not the non-susceptible stock that is responsible for it. I doubt if any one has any positive evidence that it has ever been disseminated on any of the plants in Doctor Britton's third list, although some of them have been known to be quite heavily infested. The exemption of this list with a few exceptions would in no way increase the amount of scale dissemination. It is being disseminated on fruit and susceptible ornamental stock, and this comes about in several ways. It is not possible to detect it in every case; complete supervision is not always possible, and nurserymen are not all as careful and conscientious as they should be.

While we should be just in dealing with the nurserymen, and not [pla]ce unnecessary burdens on them, we must not fail to protect as [far] as possible the buyers of their stock. Any plant which has been

exposed to attack and is known to be capable of serving as a host for the scale should be fumigated, even though scale has very rarely been found on it. The fact that it is known to be able to harbor the scale, makes it a dangerous plant and justifies the demand that it be treated. It seems to be the case that some plants are more susceptible to attack in some localities than in others. But the fact that a plant is susceptible in any locality places it under suspicion.

In determining what plants should be fumigated and what ones may safely be exempt, Doctor Britton's list serves as a safe guide. All plants in the first and second lists, and a few included in his third list which have been reported as infested since its publication should be fumigated; those remaining in the third list may safely be exempt except when they stand in very close proximity to infested stock. Some of the shrubs of that list which should be excluded are as follows: Wistaria, and *Cercis canadensis* reported as infested by Prof. G. M. Bentley; *Staphylis* sp., reported as badly infested in one instance by Prof. A. E. Stene, and Rhamnus which has been found quite badly infested in Illinois; and there are perhaps others.

The evidence thus far as to the non-susceptibility of the remaining plants of this list seems to be chiefly of a negative character. There is need of experiments along this line to secure positive evidence. It is probable that experiments will prove that the scale is not able to come to maturity and produce a new generation on some of the plants which have been reported as rarely or, slightly infested.

I feel sure that a full consideration of this subject at this time, or some future time, will prove profitable even though we may not be able to come to a mutual agreement as to a uniform method of procedure.

ENFORCING FUMIGATION AND THE ATTITUDE OF NURSERYMEN AND GROWERS TO THE TREATMENT

By T. B. Symons, *College Park, Md.*

The object of this paper is primarily to bring up a discussion of this subject among members of this Association, looking towards uniform requirements by the State Inspectors, and to point out how this work is being conducted in Maryland.

It is unnecessary to discuss before this Association the large amount of work that has been done in the past to assure us that fumigation with Hydrocyanic Acid Gas is the best, and at the same time a safe treatment, when properly conducted, of nursery stock liable to be infested with scale insects or other pests, that can be employed.

This is so generally recognized that it is believed to be required by all inspectors, and in fact is incorporated in all laws or rules and regulations that are now in force in the several States, having any legislation over the distribution of nursery stock.

While this is nominally or legally true, as you may call it, yet how many of us are assured that our instructions in this particular have always been systematically carried out.

In my experience the nurserymen have not looked upon the treatment as wholly necessary, and in fact many of them even to this day doubt the non-injurious effect of the treatment upon the stock, and feel that one requiring same is a professional whim or a dead letter.

Moreover, there are many growers who vigorously oppose the fumigation of their stock for fear that it lessens the vitality of their trees. In such cases, the nurserymen, in some instances, have allowed such growers to have their stock unfumigated, in order to make the sale.

The argument presented by the grower is that they already have scale in their orchards and do not now fear it, therefore, they do not mind buying trees that may be slightly infested, provided that they are otherwise healthy and of good vigor.

Under such conditions, it is readily seen that the nurseryman even if he is satisfied that no injury will result, readily desires to acquiesce to the demand of the grower as it saves him trouble and expense.

In order to be in position to know of the character of stock distributed, the Board of Trustees supervising this work in Maryland, has sought the coöperation of the nurserymen to the end that we now have a regular paid assistant under our immediate direction, placed at the large nurseries, during shipping season, to superintend fumigation and other treatment of stock for distribution. By this means the nurseryman has an expert at hand all the time for consultation on insect and disease control, and is assured as far as possible of having no irregularities by laborers in the fumigation or other treatment of the stock.

This arrangement has worked satisfactorily during the past season, and it is believed to be the only way by which the inspector can have first hand knowledge of the character of stock distributed. Treatment of stock at smaller nurseries is accomplished by sending assistants to the nurseries at digging time. If such arrangement could be effected in all the States, it is believed that we could largely improve the general character of nursery stock distributed.

Notwithstanding our desire to assure the grower of receiving healthy stock, and at the same time to aid the nurserymen in producing and distributing it, there are some apparent inconsistencies in the require-

ments that are hard to explain to the nurserymen or one who may be prejudiced. In cases where the San José Scale is in the nursery or a given block, it is our practice to have destroyed all trees found infested, by a hand-inspection of all the trees from the block and require fumigation of the balance.

The question is often asked why hand-inspect—when fumigation is supposed to kill all insect life on the tree, or vice versa,—when trees are carefully hand-inspected and the infested or diseased ones rejected, why subject them to fumigation? Especially as the grower does not desire it and the stock is going to an infested neighborhood.

Moreover, recently, we had a case of a car-load of trees shipped to one of our nurseries from another State, under Certificate, that was found to contain many trees infested with scale. The consignee especially desired the trees to fill orders already taken. The local nurserymen desired to use the trees and agreed to fumigate them a second time, but did not desire to return those that showed infestation as they made up particular varieties needed.

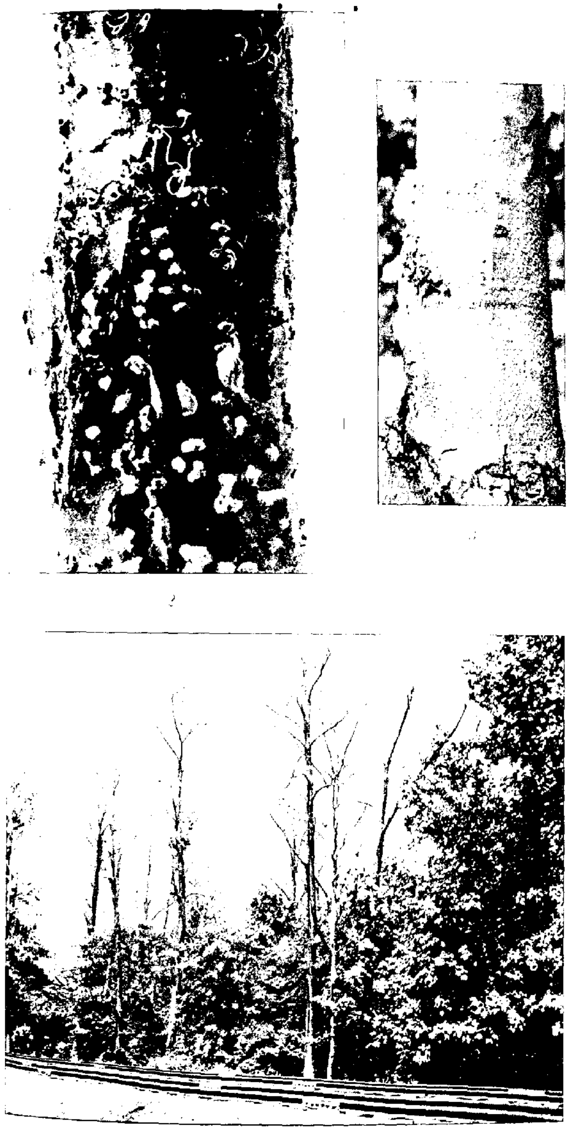
In such cases, it is difficult to satisfy the nurserymen with our arguments, that, notwithstanding the double fumigation, it was not deemed best to allow such stock to be distributed.

I believe there is room for a reasonable discussion of this subject and possibility for the inspectors in the several States to have greater uniformity in their requirements for the distribution of stock under such conditions. We must as a body of men study both sides of these questions, and as conditions develop be prepared to deal with them intelligently and reasonably. There is no doubt that both the nurserymen and growers require further education as to effect and usefulness of fumigation as well as other measures to prevent injury from insects and disease in the nursery.

THE CHESTNUT BARK DISEASE

By Dr. Haven Metcalf, *Office of Forest Pathology, Bureau Plant Industry, U. S. Department of Agriculture*

The chestnut bark disease was first recognized as a serious disease in the vicinity of New York City in 1904. Its origin is unknown, but there is some evidence that it was imported from the Orient. This view is not, however, held by all investigators, but whatever may have been its time or place of origin, it is certain that it has now spread into at least 10 States. In the vicinity of New York City and through adjacent counties it has killed practically all chestnut trees. Throughout a much larger neighboring area, practically all chestnut trees are infected. Outside of this area, throughout the country from the



Dead and dying chestnuts in mixed stand, killed by the bark disease, Richmond Hill, N. Y. 2. Pustules and summer spores of *Diaporthe parasitica*. 3. Pustules bearing winter spores.

northern border of Massachusetts and from Saratoga County, N. Y., to the western border of Pennsylvania and the southern border of Virginia, scattering areas of infection are known to occur and may be expected at any point. There is not yet the slightest indication of any cessation of spread or virulence of the disease, unless possibly locally in Virginia. The actual loss of property to date resulting from this disease cannot be estimated as less than twenty-five millions of dollars.

So far as is now known, the bark disease is limited to the members of the genus Castanea. The American chestnut, the chinquapin, and the cultivated varieties of the European chestnut are all readily subject to the disease. Only the Japanese and some other east Asian varieties appear to have any resistance.

The disease is caused by a fungus, *Diaporthe parasitica*. When any of the spores of this fungus gain entrance into any part of the trunk or limbs of a chestnut tree they give rise to a spreading canker, which soon girdles the tree. If the part attacked happens to be the trunk, the whole tree in consequence is killed, perhaps in a single season. If the smaller branches are attacked, only those branches are killed, or only those portions of branches beyond the point of attack, and the remainder of the tree may survive for several years.

Limbs with smooth bark attacked by the fungus soon show dead, somewhat discolored, sunken areas, which continue to enlarge and soon become covered more or less thickly with yellow, orange, or reddish-brown spots about the size of a pinhead. These spots are the pustules of the fruiting fungus. In damp weather or in damp situations, masses of summer spores are extruded in the form of long, irregularly twisted strings or "horns," which are at first bright yellow to greenish yellow or even buff, becoming darker with age (Fig. 2). If the canker is on the trunk or a large limb with very thick bark there is no obvious change in the appearance of the bark itself, but the pustules show in the cracks and the bark often sounds hollow when tapped. After smooth-barked limbs or trunks are girdled the fungus continues to grow extensively through the bark, sometimes covering the entire surface with reddish-brown pustules (Fig. 3).

After a branch or trunk is girdled, the leaves change color and sooner or later wither. Such branches have a very characteristic appearance and can hardly be mistaken for anything else, except in certain localities where the work of twig-girdling insects may produce a similar appearance in the spring. In case the girdling by the fungus is completed late in the season, the leaves of the following spring assume a yellowish or pale appearance and do not develop to their full size. If the girdling is completed between spring and midsummer the leaves may attain their full size and then turn a somewhat characteristic

reddish-brown color, which can easily be detected at a long distance. Later this leaf coloration changes to a more brownish tinge and the leaves are commonly persistent for a considerable time. The leaves commonly persist on the tree during the following winter, thus producing the only symptom which is at all conspicuous during the leafless season. The great damage which the disease has done in the late summer thus becomes most evident at the beginning of the next season, and that done in the spring becomes evident later in the same season, giving rise to the false but common idea that the fungus does its work at the time of year that the leaves change color, when in reality the harm was done much earlier.

Perhaps the most easily seen as well as the longest persistent symptom of the bark disease is the prompt development of sprouts on the trunk of the tree and at its base, or somewhat less frequently on the smaller branches (Fig. 1). Sprouts may appear below every girdling canker on a tree, and there are usually many such cankers. These sprouts are usually very luxuriant and quick growing, but rarely survive the third year, as they in turn are killed by the fungus. The age of the oldest living sprout, as determined by the number of its annual rings, is an indication of the minimum age of that portion of the infection immediately above it. Sprouts are sometimes produced as a result of other injuries; for instance, trees girdled by borers may develop sprouts, but these are generally less rapid in growth and are distributed with greater uniformity over the trunk.

The disease is spread by the spores of the fungus, of which there are two kinds. Both kinds of spores appear to be sticky, and there is little evidence that they are transmitted to any distance by wind except when washed down into the dust and so blown about with it. The spores are spread easily through short distances by rain, particularly they are washed down from twig infections to the lower parts of the tree. There is circumstantial evidence that the spores are spread extensively by birds, and there is excellent evidence that they are spread locally by insects and by various rodents, such as squirrels. The disease is carried bodily for considerable distances in tan bark and unbarked timber derived from diseased trees. One of the most prolific sources of general infection has been the transportation of diseased chestnut nursery stock from infected to uninfected localities.

When the spores have once been carried to a healthy tree, they may develop in any sort of hole in the bark which is reasonably moist. These may be wounds or mechanical injuries, but by far the most common place of infection is a tunnel made by a borer. Borers' tunnels are usually moist, even in dry weather, and in them the spore finds surroundings favorable to its development.

No definite evidence, experimental or otherwise, has been adduced to show that a tree with reduced vitality is more susceptible to infection, or that the disease spreads more rapidly in such a tree, than in a perfectly healthy and well-nourished tree of either seedling or coppice growth, provided that such reduced vitality does not result in or is not accompanied by bark injuries through which spores can gain entrance.

The control of the disease. From the standpoint of pure science, we are not equipped to cope with the situation as it presents itself. The disease attracted no attention until 1904, and it was not until 3 years later—1907—that an office was organized in the U. S. Department of Agriculture for the exclusive study of forest and ornamental tree diseases. Great conservatism has prevailed regarding the contagious nature and seriousness of the disease. Local investigators have paid little attention to its practical aspects. Obviously, treatment must be more or less empirical, and based upon analogies with general sanitary methods rather than upon accomplished experiments. For while experiments have been made on the method of control by elimination of advance infections, and have so far been successful, they are too few in number and too local in distribution to be absolutely conclusive. Yet they are indicative, pointing strongly to the ultimate success of the method of elimination of advance infections.

If extensive practical investigations of this disease could have begun in 1904 or earlier, we would now have a body of knowledge upon which we could base accurate and final conclusions. And such research could have been conducted at a very small expense—a mere fraction of the property loss already caused by the disease. But now it is too late to merely experiment. It is an old law in the practice of medicine, that when the patient is already moribund, the best remedy that presents itself must be applied, whether conclusively proved to be efficient or not: and this law applies equally well to plant pathology. The method of cutting out advance infections is open to many criticisms, but so far no other method of dealing with the situation has been even proposed.

For legal reasons, the actual elimination of the advance infections must be done under state, not national, authority; and for this reason responsibility for action or inaction lies with the several states in which the chestnut tree is a valuable asset. So far the only state to take up the problem vigorously is Pennsylvania. In this state the work is being carried on under a special law. In may other states, as in New York, the work can doubtless be carried on under the existing crop pest laws.

For more complete discussion of control methods, reference is made

to Farmers' Bulletin 467, "The Control of the Chestnut Bark Di- and to future publications of the Chestnut Tree Blight Comm of Pennsylvania. Perhaps the feature of control of most inte Horticultural Inspectors is the inspection of diseased chestnut n stock.

As has been indicated, such stock has in the past been a most i tant factor in the spread of the bark disease. On account of grounded fear of this disease much less chestnut nursery st being moved now than formerly, but there is still enough to con a serious source of danger. It is therefore obvious that every in which the chestnut grows, either naturally or under culti should as speedily as possible pass a law putting the chestnu disease on the same footing as other pernicious diseases and pests, such as peach yellows and the San José scale, against quarantine measures are taken. Many inspectors already legal power to quarantine against the bark disease on chestnut n stock, and they should now take special care that no shipment, ever small, escapes their rigid inspection.

The most serious practical difficulty in inspecting nursery for this as for other fungous diseases lies in the fact that pra all state inspectors are necessarily entomologists, and are not in recognizing the more obscure symptoms of fungous diseases. N ery trees affected by the bark disease rarely show it prominent the time when shipped; the threads of summer spores or the y or orange pustules are rarely present, and usually all the insp can find is a small, slightly depressed, dark-colored area of dead usually near the ground, which is easily overlooked or mistaken some insignificant injury. Upon cutting into such a spot, the bark shows a most characteristic disorganized "punky" appear quite different from that of any other bark injury; but it is impo to adequately describe this appearance without recourse to illustrations. Occasionally a yellowish-brown band, either gi or partly girdling the young tree, may be seen; this is very char istic, but is so prominent a symptom that it may be noticed nursery, and presumably trees so affected will not be shipped.

If infected trees are set out they develop the disease with it acteristic symptoms the following spring. But on account small size such trees are girdled and die before the end of the su often in two or three weeks. Meanwhile they are spreadi disease to neighboring orchard and forest trees. Orchardist nurserymen purchasing chestnut trees should therefore be war watch them closely during the first season, no matter how rigid may have been inspected.

MR. BERGER (*Florida*). Does this disease act to any extent on other trees?

MR. METCALF: The Chinquapin is absolutely subject to the disease and that species will take the same course as the chestnut tree. The Japanese Chestnut is highly resistant; so much so, that at one time it was thought to be immune to the disease. The Korean chestnut appears to be also highly resistant. The European varieties of chestnut are apparently quite as susceptible as American species and varieties.

A MEMBER: Where does this disease come from?

MR. METCALF: That is exactly what we would like to know more about. The fact that the disease has obviously spread from a center leads me to believe that it is an importation rather than a disease which has developed here. The fact that the locality from which it has spread is the same locality into which the Japanese chestnut was first extensively introduced; that the Japanese and Korean chestnuts are highly resistant and are the only varieties that are at all resistant—all suggests the hypothesis that the fungous parasite may have come from the Orient. However, the origin of the parasite is not a matter of practical importance unless it could be shown that the fungous parasite is developing spontaneously in many localities from some native saprophytic form, in which case the difficulties of control would be greatly increased. This suggestion is, however, so far-fetched that we do not need to consider it seriously until some facts are adduced to support it. The main fact is that the disease is here, and it is up to us to decide whether to fight it with the best means we have at hand or to let it go.

A MEMBER: What are the fundamental principles of natural inoculation?

MR. METCALF: We are not sure that the disease can enter a tree in any way, but through wounds. Any of you who are familiar with the chestnut tree, know of the injuries made by various kinds of insects. I have not the slightest doubt that in ninety per cent of all cases of this disease, the fungus found entrance through lesions made by insects. The spores are sticky in character and may be transmitted by water, by birds, by insects, and to a large extent by human agency; doubtless also in other ways.

MR. FERNALD (*Mass.*): From what we have said, does it not follow that in case this disease is found present on nursery stock there is only one possible treatment,—the absolute destruction of the tree?

MR. METCALF: This is unquestionably the case. I think the specimen here shows the characteristic form of the disease on nursery

stock. Mr. A. B. Brooks of W. Va., found near the center of the State a tree in an advanced stage of this disease. He had the tree destroyed, made a very thorough search all through that locality but could not find any other cases. He followed the matter up and found that the tree had been brought from a nursery near Philadelphia. That diseased tree, was, so far as we know, about 100 miles from any other diseased tree and was right in the heart of some of the best chestnut timber in West Virginia,—and that shows one of the most prolific ways in which the disease has unquestionably spread.

Mr. Norton: Is there any chance that this disease spreads more rapidly or causes more damage in the North than in the South?

Mr. Metcalf: It unquestionably has so far, but it started in the north: it is spreading as rapidly in Maryland as in Massachusetts. However, there is little basis at present for believing that it will slow down as it moves south or west.

Mr. Surface: I would like to ask how it is found on any trees and if it is sufficient to destroy those possibly infected?

Mr. Metcalf: The disease is clearly obvious on large trees. Of course, when you find the disease on nursery stock, there is nothing to do but destroy it.

Mr. Norton: Do you think it would be advisable to stop the propagation of stock from infected nurseries?

Mr. Metcalf: I think so decidedly. An absolute quarantine should be put on infected nursery stock. I have not the slightest doubt that this disease has been transmitted to orchards in the West and on the Pacific Coast, although we have no positive evidence of that.

Mr Hopkins: Doctor Metcalf's remarks about the relation of insects to the chestnut blight, I am sorry to say, brings the Division of Forest Insects of the Bureau of Entomology into the trouble. This chestnut disease problem has reached a point where it is absolutely necessary to know something about the relations of insects to the disease and to the dying of the chestnut. It is our plan to make a very thorough investigation to determine some of the fundamental facts about the insects to serve as a basis for conclusions and recommendations relating to methods of combating those which kill the trees on their own account and those which contribute to the spread and development of the disease.

Certain insects are known to be the cause of the death of chestnut trees and undoubtedly they have been killing some of the trees within the present areas affected by the disease.

I made some studies of the insects affecting chestnut trees in West Virginia between 1894 and 1901, and to some extent since [illegible]

tion with the Bureau, and, owing to the extensive dying of chestnut in the southern Appalachians, nearly the whole season of 1904 was devoted to a study of chestnut insects by an agent of the Bureau at our field station located at Tryon, N. C.

Therefore, we have already a large amount of data on the subject. Our notes and bibliographical references indicate that more than 300 species of insects inhabit the chestnut, including those which are destructive, injurious, beneficial, and neutral in relation to the tree or its products.

We find references to extensive dying of chestnut timber in the middle and southern Appalachians more than forty years before the present disease was discovered in America. We also find that while insects have been the cause of the death of a considerable percentage of the chestnut within this same region within the past fifteen or twenty years, they are by no means the cause of the prevalent trouble which has practically exterminated the chestnut over large areas in Virginia, North Carolina, and South Carolina.

Therefore, it is evident that the chestnut throughout its range has been for a long time in an unhealthy condition.

We have arranged to coöperate with the Pennsylvania Chestnut Tree Blight Commission in a thorough study of the relation of insects to the inoculation and spread of the disease in that State, but we are not going to confine our work on chestnut insects to one state. We are going to make it one of the special features of the Division of Forest Insects during the coming season and as many other seasons and in as many states as may be necessary to determine the essential facts.

The problem of interrelation between insects and diseases is a most complex one which will require the closest kind of co-operation between the Forest Pathologist and Forest Entomologist. We expect to refer everything we find that looks like a fungous or bacterial disease to Doctor Metcalf and, naturally, he will refer all insect matters to us and we will have to work together on the interrelated problems.

The whole problem is one which will require a great deal of scientific investigation before we can arrive at definite conclusions or adopt the best methods of protecting the chestnut from its fungous and insect enemies.

Mr. Metcalf: I am glad to know that legislation now pending makes it obligatory to take up this work. Regarding the situation in the South, I think there cannot be the slightest question that in the past fifty or eighty years, radical changes have taken place in the range of the chestnut. Many of the facts of the destruction and the death of the chestnut tree years ago, are matters of written record, and although inadequately described, these old accounts led us to inves-

tigate the situation in the South Appalachians. Two years ago Dr. Arthur H. Graves, of Yale, spent the summer in the South Appalachians looking over considerable areas, to see if the trouble there was the chestnut bark disease. Some little work on this has, I believe, been done by Mr. Barre, of South Carolina, and between 1902 and 1906, I made rather extensive observations myself in that state. The results are that no one has yet found the bark disease south of Bedford County, Virginia.

Mr. Symons: I would like to know briefly how the Commission in Pennsylvania is expending its money,—that is to say, the means it is providing to establish its quarantine or methods of preventing its spread?

Mr. Metcalf: Briefly, in the absence of any representative of the Commission, I can say that the mode followed is to first establish an instruction camp, to instruct all the persons of their employ in regard to all phases of the disease; second, they send these people out to scout the state, and locate all advance spots of infection. Beginning on the west, they will destroy the advanced points of infection as found, and working back to the east, in this way they will locate some point, where probably some sort of a quarantine line will be established.

President: If there are no further comments or questions in regard to this paper, we will call for the next.

THE PRESENT STATUS OF CROWN GALL

By J. B. S. Norton

At the present time there is, in spite of much study and investigation of the subject, considerable disagreement among nurserymen, inspectors, and even plant pathologists with regard to the danger to fruit culture from Crown Gall.

After the exhaustive work of Dr. Erwin Smith and others in the U. S. Department of Agriculture, there can be no doubt of the infectious nature of the disease or of the specific bacterium that causes it. This work has shown that the disease is very widely distributed and occurs upon a great variety of hosts, including many herbaceous plants, as well as trees and shrubs. Doctor Smith has recently pointed out also its remarkable similarity to cancer in animals.

The wide spread distribution of the germ will explain some of the cases of nursery stock acquiring the disease when grown on new ground never before cultivated, though the germ may also be introduced in apparently healthy parts of infected plants. With these facts in view, the danger of infecting new areas can be somewhat minimized

and the advice to grow on non-infected soil will have less value: though, of course, ground occupied by a thoroughly infected raspberry patch would be much more dangerous for a new plantation than a piece of ground with a little chance natural infection.

The opportunity of wounds affording entrance for the germ is very important, and any means of preventing or protecting exposed tissues is of value in controlling the disease.

I think most of us will agree that crown gall is very destructive to raspberries, less so to blackberries, and is quite serious on some stone fruits, particularly, if infected when young. There is much doubt of it being very serious on apple, except possibly on quite young trees. A number of responsible men have pointed out orchards several years in bearing and in apparently perfect condition, which were planted from infected stock, while others cite cases when especially under unfavorable conditions diseased nursery stock has failed to make good trees, or where gall trees show great tendency to secondary infections at the crown, or to break off at this point, or to have a much increased tendency to throw up sprouts from the root. Whether the length of bearing life would be much less in affected trees, time must tell.

Even in kinds of fruit where there is little danger from the gall disease, it must be remembered that the work of Hedgecock, Smith, and others, has shown that the germs from these slightly injured trees may infect other species that would be soon killed by them.

Hippodamia ambigua Lec. in Massachusetts. A package of celery was delivered in January to a customer in Amherst. In the warm room, beetles resembling the "lady bugs" of this vicinity, crawled out in large numbers. Considerably over twenty-five were gathered up and destroyed. The celery was then put away in a cool place but later, upon being opened, a cluster of twenty-four beetles was found in the heart of the leaves. In all, there must have been upwards of fifty individuals in the original cluster.

The specimens were identified by Mr. Arthur I. Bourne of the Massachusetts Agricultural College Experiment Station, as the *Hippodamia ambigua* Lec. The identification was confirmed by Mr. Charles Schaeffer of Brooklyn Museum. Without either of these entomologists knowing it, the merchant who sold the celery, previously had pronounced it from California.

It is well recognized, I believe, that this species has the habit of clustering in large numbers. This behavior was exceptionally pronounced. The twenty-four specimens in the bottle remained in a compact ball when darkened. Upon receiving light, however, they scattered and climbed the sides of the bottle in the sun.

Another peculiar feature was the drinking of a drop of water. This observation was accidental, a beetle being confined under a tumbler in which there had been water. Drops of considerable size were readily taken. The first instance was observed immediately after a beetle had been warmed up sufficiently to crawl.

BURTON N. GATES,
Massachusetts Agricultural College, Amherst.

THE POSITION ASSUMED BY FEMALE GRASSHOPPERS WHEN OVIPOSITING

By F. B. MILLIKEN, *Assistant Entomologist of the Kansas State Agri. Experiment Station*

In view of the fact that all available illustrations of ovipositing grasshoppers represent the female with her abdomen curved forward under the body, the writer was surprised while studying grasshoppers at Dodge City, Kansas, during the summer of 1911 to find that none of the species which were common there assumed this position as the normal one. Ten *Melanoplus bivittatus* Scud., six *Dissosteira carolina* Linn., and one *Schistocerca shoshone* Thos., were examined while ovipositing by excavating at the side of the abdomen before the latter was withdrawn from the tunnel or the insect had changed its position. Of these only one—a specimen of *Melanoplus bivittatus*—had the abdomen curved forward. This one had encountered an impenetrable mass of grass roots

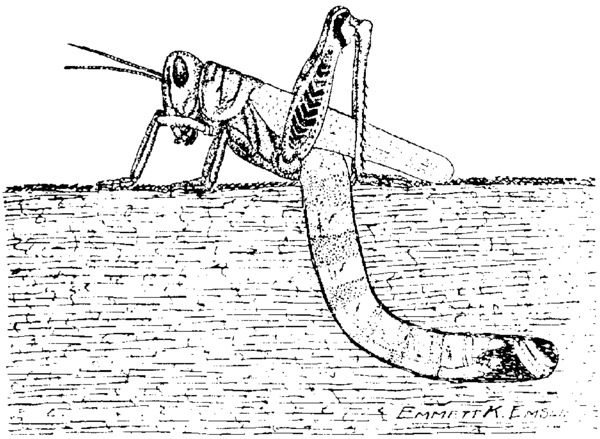


Fig. 3. Grasshopper ovipositing (original)

which altered the direction of the tunnel and inclined the abdomen forward. The remainder ran the abdomen down a short distance below the surface and curved it backward from the body. The curvature varied from a slight inclination to the rear at the tip to an angle that brought the posterior portion of the elongated abdomen parallel with the surface of the ground. No *Melanoplus spretus* were observed in the act of oviposition, as none were found in that vicinity this year.

The writer has recently found a correct account of the oviposition of *Melanoplus differentialis* by Hunter in California Bulletin 170, 1905 but no illustration is given.

JOURNAL OF ECONOMIC ENTOMOLOGY

OFFICIAL ORGAN AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

APRIL, 1912

The editors will thankfully receive news items and other matter likely to be of interest to subscribers. Papers will be published, so far as possible, in the order of reception. All extended contributions, at least, should be in the hands of the editor the first of the month preceding publication. Reprints may be obtained at cost. Contributors are requested to supply electrotypes for the larger illustrations so far as possible. The receipt of all papers will be acknowledged.—Eds.

This issue reflects the increased importance of shade tree insects, pests which, in connection with untoward climatic and other conditions, have brought about an acute situation in the northeastern United States, at least. It is the logical outcome of extensive plantings of one or two varieties through a long series of years. The first essential is to afford speedy relief by the general adoption of methods for checking insect depredations. This should also be accompanied by a recognition of the underlying causes, with a view of adjusting conditions in the future in such a way as to minimize the danger of extended injuries. The horticulturist and landscape gardener should advocate more diversified plantings and endeavor in the near future to correct, so far as practical, the illogical settings of earlier years. Maples and elms, while admirable shade trees in many respects, are by no means the only species which can be planted to advantage upon streets and in parks.

Most economic entomologists will concede that the *Bibliography of the More Important Contributions to American Economic Entomology* is an exceedingly useful compilation, since it includes in eight small parts the writings of all American economic entomologists up to January 1, 1905. We have been expecting for some time another issue bringing the bibliography down to 1910 and were surprised to receive, in response to an inquiry, the statement: "By decision of the Secretary of Agriculture" such work would in the future be limited to the *Experiment Station Record.* This latter publication is of great service to the economic entomologist and is frequently consulted. Nevertheless, we favor the publication of the bibliography of economic entomology and trust that the Federal Authorities will continue the issuance of this extremely serviceable and convenient work, a compilation of greatly increasing value with the advance of years. A readily available literature is an important factor in research work of all kinds.

Obituary

JOHN BERNHARDT SMITH

JOHN BERNHARDT SMITH, Sc. D., who died March 12, 1912, at the age of 54 years, had for many years been a conspicuous figure in the entomological world and his contributions in Economic Entomology have been so numerous and important that his name must remain a familiar one to the workers in Economic Entomology for the future.

Doctor Smith was born in New York City November 21, 1858, and his early life was spent in the same vicinity but from the time that he entered upon his work at the National Museum in 1886, until his death at New Brunswick, New Jersey, his life has been so associated with work in entomology that he can hardly be thought of as belonging to any one locality in his influence. With his early life the writer is not familiar, but since our first meeting in 1884, scarcely a year has passed but what we have met at some of the various associations connected with entomological work, and while my acquaintance with him has been restricted to such occasional meetings and to a short association in Washington, I feel that the acquaintance has by no means restricted my opportunity for appreciation of his qualities and I may speak with confidence as to the worth of the man and the quality of his work. Professor Smith came into the work in entomology from a professional career in law, being attracted to it as are many devoted students of science, by his native talent and an association with enthusiastic students of this branch of science, largely at first, no doubt, from the standpoint of recreation, but it soon came to be with him a ruling passion and from the year 1884 when he commenced work in the United States Department of Agriculture, it was unquestionably the paramount interest of his life. In 1886 he moved to Washington to take up the position of Assistant Curator of Insects in the United States National Museum and while there did much to bring together and classify the somewhat chaotic mass of insects that had accumulated, the results of various surveys and of the collections from the Department of Agriculture, and the extensive collection brought together by Dr. C. V. Riley. In 1889 he resigned this office to enter upon his duties as Professor of Entomology at Rutgers College and Entomologist of the Experiment Station of New Jersey. Later, in 1894, he was made official State Entomologist for New Jersey and this position, with Entomologist of the station and the professorship in Rutgers College were retained until his death. The service he has rendered to New Jersey in these various capacities it would be hard to measure but we certainly can say that in no state in the Union has

John B. Smith

the work in entomology been pushed with greater vigor and with a more devoted effort to make the work of value to the people of the state.

Professor Smith, however, was a man of diversified talent and of a wide range of activity so that the results of his life work will be seen in many different phases of entomology. He was perhaps primarily a systematist and entered upon entomological work with this as his stimulus and throughout his life he continued to do much in the way of classification and arrangement of the groups of insects, most particularly in the *Lepidoptera*, in which he was a recognized authority and in which, especially in the *Noctuidæ*, his contributions have been of great extent and undoubted merit. In the field of insect anatomy he has made a number of contributions, particularly upon the structure of the Diptera and Hemiptera, and whether his views in these matters, which were somewhat revolutionary, be accepted or not, there can be no question as to the service given by his observations and interpretations in this field. In economic entomology which has perhaps engaged the greater share of his time during the past quarter-century, he has contributed extensive reports, embracing results of his studies in the State of New Jersey and covering practically all groups of insects and in greater or less degree nearly every species of economic importance in his state. His work upon the mosquito problems was prosecuted with special vigor and interest and the results have been marked and will undoubtedly show the greatest value in years to come. His lists of "Insects in New Jersey" which must have involved an enormous amount of labor, stand as among the best in this class of work and have afforded much help to students of geographical distribution.

Personally, Professor Smith was a man of very distinct convictions but of a genial, wholesome spirit, one whom it was a pleasure to know and his friendship extended practically to the whole number of working entomologists of the country and included many of the entomological workers of other countries. He was a member of many different scientific societies and an active worker in these, and was honored by prominent duties and offices in many of them, those showing particular confidence and esteem on the part of his fellow-workers, holding the Presidency of the Association of Economic Entomologists in 1895, and that of the Entomological Society of America in 1910. He was Secretary of the American Association for the Advancement of Science in 1894.

Aside from the numerous and voluminous bulletins published as a part of his experiment station work, and the extended papers on Systematic Entomology, many of which were published in the Proceed-

ings of the National Museum, he was author of a book on "*E… Entomology*" which has had a wide circulation and has been … service in the education of entomological workers, and of … entitled "*Insect Friends and Foes*," intended for popular readi… which must have had an extended influence in distributing in… tion concerning insect life. His *Glossary of Entomology* is … important work. Doctor Smith was editor of *Entomologica Am…* from 1882 to 1890 and in 1891 was awarded the honorary deg… Doctor of Science by Rutgers College. He was always genero… both his time and his material, in assisting anyone intere… entomological work. No small part of his service to entomo… science may be found in the numerous collections which he has … fied for various students, and the specimens freely loaned for … gation in other hands.

HERBERT OSBORN

Reviews

RECENT MEXICAN PUBLICATIONS ON ECONOMIC ENTOMOLOGY

During the existence of the Comision de Parasitologia Agri… under the direction of Prof. A. L. Herrera, the Mexican Governm… published a number of bulletins and circulars on entomological s… jects. The series came to an end in 1908 on account of the disco… tinuance of the Comision by administrative action. Recently, how… ever, publications on economic entomology have been resumed … Mexico. They appear as bulletins or circulars of the Estacion Agric… Central and its various branches. The writers in several cases … entomologists who were formerly associated with Professor Herr…

These commendable publications are intended largely to popul… entomology in Mexico but are of interest to entomologists in … United States for several reasons. They deal in some instances w… pests which are more or less likely to be introduced in the Un… States in the future, and with methods of control of species w… occur in the United States, the Mexican remedies for which mus… different on account of the utterly different conditions prevailing … that country. The recent works are of several classes such … treatment, in monographic form, of the pests of some particular … reports on special trips of investigationa and leaflets designed pri… to popularize the subject of entomology in Mexico.

Much of the work being done is of a pioneer nature and … the publications consequently are similar to those issued by the … ment stations in this country soon after their establishment …

... hoped that the work now so well begun will be continued and ... develop as it has in the United States.

R. Ramirez and J. R. Inda. **Las enfermedades del jitomate.** Bull. ... Estacion Agricola Central, 1911.

This publication is a general treatment of the insects and diseases of the tomato in Mexico. It covers 46 pages and is accompanied by 16 plates, several of which are in colors. The insects are treated in several groups — those injuring the leaves and stems, those injuring the flowers and fruit and those affecting the roots or boring in the stems. The species of the last group are comparatively little known so that ... of the discussion deals with the forms affecting the leaves, blooms and fruit. In the list of species injuring the stems and leaves there are 18, while the forms affecting the flowers and fruit number five species. The majority of the pests with which the bulletin deals are species which occur in the United States. A number of additional species remain for further treatment.

W. D. Hunter.

[Notices of other bulletins in this series will appear in the next issue. Ed.]

Insect Pests of Farm, Garden and Orchard, by E. Dwight Sanderson, pp. I–XII, 1–684; 513 figures. John Wiley & Sons, 1912.

The entomologist will welcome this much needed addition to his general reference library, while the farmer and fruit grower have a profusely illustrated and exceedingly ... compendium giving the life history and methods of control for practically all of their more injurious insects aside from those affecting citrus fruits. The scope of the work is indicated by the titles of the chapters, dealing with insects affecting grass, grasses, forage and miscellaneous crops, small grains, corn, stored grains, clover, tobacco, cotton, hop, potatoes and tomatoes, beans and peas, beets and spinach, cruciferous crops, melons, cucumbers, squash, etc., miscellaneous garden crops, sweet potatoes, strawberry, raspberry and blackberry, currant and gooseberry, orchard fruits, apple and pear, peach, plum, cherry and stone fruits. The author, in his groupings, has endeavored to avoid unnecessary duplication and has succeeded admirably in most instances. A few of the titles of the chapters are perhaps too extensive, possibly unavoidably so, while some might take exception to the location of certain pests such, for example, as the plum Curculio in the chapter devoted to orchard fruits. Most parties familiar with this insect would probably look for it in the chapter discussing the stone fruit insects, though we must admit that it is an orchard pest. There are very few errors. We note on page 124 an evident slip of the pen to the effect that the larva of the Hessian fly has no true head, while on page 153, Elymus is probably given as Elynius and there is also a typographical error on page 628.

The work is well written and the illustrations, while somewhat miscellaneous in character, are, for the most part, the best obtainable. They add greatly to the value of the publication. The letter press and paper are excellent. The author is to be congratulated on having produced a work which must take its place among the standard volumes on economic entomology.

E. P. Felt.

Current Notes

Conducted by the Associate Editor

G. H. Verrall, the eminent English dipterist, and a former president of ... mological Society of London, died September 16, 1911, at sixty-four years ...

Mr. E. S. Tucker of the Bureau of Entomology is studying the insects ... stored rice, and is located at Baton Rouge, La.

Mr. E. W. Stafford, who resigned from the New Jersey Agricultural Ex... Station, has been appointed assistant entomologist of the Oklahoma Stati...

Dr. C. W. Hooker of the Bureau of Entomology has been appointed ent... of the Porto Rico Federal Experiment Station, and has entered upon his d...

Messrs. Harper Dean and F. B. Paddock of the Texas Agricultural Col... also been appointed assistant entomologists of the experiment Station. ... Dean will give his entire time to the Station work.

Professor G. M. Bentley, State Entomologist of Tennessee, was recently r... secretary-treasurer of the Tennessee State Nurserymen's Association, at i... meeting held at Nashville.

Mr. John D. Tothill, B.S.A., formerly in charge of the Tachinid para... at the Gypsy Moth Parasite Laboratory at Melrose Highlands, Mass., ... appointed to the Canadian Division of Entomology, and is at present in ch... the brown-tail moth campaign in New Brunswick.

Mr. Germain Beaulieu, B. A., LL. B., who has devoted particular atte... the insects of the province of Quebec, has been appointed to the staff of the C... Division of Entomology, and, in addition to carrying on investigations in Q... will study particularly the heteropterous Hemiptera.

During a recent visit to England, Doctor Hewitt, Dominion Entomolo... Canada, searched for the parasites of the larch sawfly, and discovered a lo... which they were fairly abundant. An attempt will be made to introduce th... Manitoba, where the sawfly is spreading westward.

Mr. Wm. A. Ross, B. S. A., of the Agricultural College, Guelph, Canada, ... was carrying out investigations on the apple maggot under the direction of M... Caesar of that college last year, has been appointed as field officer, and will ... in a field station in the Niagara Peninsula of Ontario.

It may be of interest to note that during the present season's inspection ... pean nursery stock by the Canadian Division of Entomology under the "Des... Insect and Pest Act," of which work Mr. Arthur Gibson, Chief Assistant E... ogist, has charge, pupae (fortunately dead) of the gypsy moth were found o... imported into Ontario from Belgium, indicating the possibility of the imp... of this insect on such plants.

According to *Science*, the late Dr. A. S. Packard of Brown University was ... on a third volume of the series on the Bombycid Moths of North Amer... volumes of which have been published by the National Academy; the thir... of the large silk-producing moths, and the material had been placed in th... of Prof. T. D. A. Cockerell of the University of Colorado, who will edit it fo... cation.

Mr. [illegible] H. Merrill, a graduate of Dartmouth College and a graduate student of the Massachusetts Agricultural College, has been appointed assistant entomologist of the [illegible] Station and instructor in the college, succeeding L. M. Peairs, who [illegible] to accept a position at Morgantown, West Virginia.

[illegible] following delegates were appointed by President S. A. Forbes to represent [illegible] Entomological Society of America at the celebration of the one hundredth anniversary of the founding of the Academy of Natural Sciences at Philadelphia, March [illegible] 21. Prof. John B. Smith, Rutgers College, New Brunswick, N. J.; Dr. [illegible] Howard, Bureau of Entomology, Washington, D. C.; Dr. E. P. Felt, State [illegible] Entomologist, Albany, N. Y.; Prof. W. M. Wheeler, Bussey Institution, Forest Hills, Mass.; Dr. W. E. Britton, State Entomologist, New Haven, Conn.

[illegible] Washington meeting of the Entomological Society of America, the following [illegible] were elected for 1912: President, S. A. Forbes; First Vice-President, A. D. [illegible]; Second Vice-President, C. P. Gillette; Secretary-Treasurer, A. D. MacGillivray; additional members of executive committee, J. H. Comstock, J. B. Smith, [illegible] Skinner, Herbert Osborn, E. D. Ball, and P. P. Calvert; member of Committee on Nomenclature for three years, H. T. Fernald.

[illegible] growth of the entomological work of the Canadian Department of Agriculture [illegible] by the additions to the staff of the Division of Entomology during the [illegible]. The most notable is the appointment of Mr. J. M. Swaine, M. Sc., B.S.A., [illegible] on the staff of Macdonald College, Que., as assistant entomologist to take [illegible] of the forest insect investigations. Mr. Swaine's published work on the [illegible]-infesting species of Coleoptera, particularly the Ipidae, is sufficient to indicate [illegible] ability to take full advantage of the unexcelled opportunities for work [illegible] Canadian forests.

[illegible] meeting of the Entomological Society of Washington December 7th, [illegible] following officers were elected for 1912: A. L. Quaintance, President; [illegible] Busck, First Vice-President; A. N. Caudell, Second Vice-President; E. R. [illegible], Recording Secretary; S. A. Rohwer, Secretary-Treasurer; H. G. Dyar, [illegible] Banks and E. A. Schwarz, additional members of the Executive Committee. [illegible] A. L. Quaintance was elected to represent the society at the Washington Academy of Sciences.

Mr. C. S. Spooner and Mr. H. B. Scammell, assistants in entomology at the University of Minnesota, have resigned, the former to accept a position with the State Entomologist of Georgia, and the latter has been appointed county inspector of [illegible] and orchards in Colorado.

[illegible] C. W. Howard of Cornell, known in connection with grasshopper work in [illegible] Africa, and at present with the Rockefeller Institute, New York City, has [illegible] appointed to an instructorship in the Division of Entomology, University of [illegible]. While connected with the University Mr. Howard will pursue work [illegible] to a doctor's degree, his major being in Economic Entomology.

Dr. Creighton Wellman, Director of the Laboratories of Hygiene and Tropical [illegible], New Orleans, La., who is making a study of the Coleopterous family [illegible], has just returned from a voyage to Central America, where he was sent [illegible] recuperate after an illness of several months in the hospital. Doctor Wellman [illegible] expects to continue his work.

[illegible] name of Prof. Robert Newstead has been selected by the council for recommendation to membership in the Royal Society.

Mr. O. G. Babcock, of College Park, Maryland, has been elected as as... the Entomological Division University of Minnesota in charge of the ... These two appointees take the places of Mr. C. S. Spooner and Mr. H. B. S... respectively, the first of whom goes to Georgia, accepting a flattering offer ... State Entomologist there, the latter having been elected County Inspector ... series and Orchards in Colorado.

According to *Science*, Dr. L. O. Howard, received the honorary degree ... of Laws on the occasion of the celebration of the one hundred and tw... anniversary of the University of Pittsburgh.

Prof. J. H. Comstock of Cornell University, Ithaca, N. Y., and Dr. W. J. H... of Pittsburgh, Pa., have been appointed by the London Entomological So... its representatives at the celebration of the centenary of the foundation of ... emy of Natural Sciences of Philadelphia.

Professor Herbert Osborn has been designated to represent the Americ... ciation of Economic Entomologists at the Second International Ento... Congress to be held at Oxford, England, August 5 to 10, 1912.

Samuel Henshaw has recently been appointed director of the Museum of C... parative Zoölogy of Harvard University.

The transmission of insects and nursery stock through the mails. At ... gestion of Dr. L. O. Howard, Chief of the Federal Bureau of Entomology, we re... duce below, sections 7 and 8, order number 6158 issued by Postmaster-G... Hitchcock under date of March 23, 1912.

"7. Queen bees and their attendant bees, when accompanied by a cer... from a State or Government inspector that they have been inspected a... free of disease; beneficial insects, when shipped by departments of entomo... agricultural colleges and persons holding official entomological positions; ... insects, when addressed to the Bureau of Entomology of the United States De... ment of Agriculture, to departments of entomology in State agricultural colle... to persons holding official entomological positions, and dried insects and dr... tiles may be sent in the mails when so put up as to render it practically im... that the package shall be broken in transit, or the persons handling the sam... jured, or the mail bags or their contents soiled.

"8. Nursery stock, including field-grown florists' stock, trees, shrubs, ... vines, cuttings, grafts, scions and buds (which may carry injurious insects ... admitted to the mails only when accompanied by a certificate from a State or ... ment inspector to the effect that said nursery stock has been inspected ... free from injurious insects."

Dr. Howard adds that he is trying to get a modification of this order in re... the inspection certificate for queen bees.

The above restrictions upon transmission of nursery stock through the ... essential if we are to prevent the dissemination of injurious insects and ... diseases. There has been complaint for some years respecting this pha... traffic, and all interested in conserving our agricultural interests can not but ... this much needed restriction.

E. P. ...

Mailed April 25, 1912.